

BACHELOR OF SCIENCE (MICROBIOLOGY)

VISION

To produce intellectual mind and qualified professionals through innovative research and inventions for the enhancement of society.

MISSION

- To establish overall competence among the students by inculcating energetic thinking and positive spirit.
- To cultivate knowledge, skills, values and confidence for the student's excellence through research in their area of expertise or interest.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1: To build graduates professionally competent in Microbiology to solve problems in society.

PEO2: To demonstrate proficiency and practice biotechniques through lifelong learning.

PEO3: To perform as an individual or team with professional and ethical behavior.

PROGRAMME OUTCOMES (PO)

After completion of the programme, the graduates will be able to

PO1: Apply the knowledge of domain and fundamental science to solve problems relevant to the needs of the society.

PO2: Identify, formulate and review research literature for providing substantial conclusion for complex problems.

PO3: Function effectively as an individual and as a member or leader in diverse team and in multidisciplinary settings.

PO4: Demonstrate knowledge and understand the principles and apply these to one's own work as a member in a team to manage projects and come with solutions for multidisciplinary environment.

PO5: Apply the ethical principles and commit to professional ethics and responsibilities in multidisciplinary practices.

PROGRAMME SPECIFIC OUTCOMES (PSO)

After completion of the programme, the graduates will be able to

- PSO1:** Design and execute industry oriented experiments in microbiology using standard techniques.
- PSO2:** Apply the domain knowledge and technology to develop research skill for commercialization of microbial products.
- PSO3:** Evaluate the need and impact of scientific solutions for sustainable development of society.
- PSO4:** Analyze the conceptual domain knowledge for innovative research and lifelong learning.
- PSO5:** Create and develop the employable, entrepreneur and socially responsible citizens.

**BACHELOR OF SCIENCE (MICROBIOLOGY)
REGULATIONS**

ELIGIBILITY

A candidate who has passed higher secondary examination in any one of the biological sciences (Botany/ Zoology, Biology) (Academic/ Vocational Stream- Agri, Home Science, Poultry) under higher secondary board examination, Tamil Nadu or as per norms set by the Government of Tamil Nadu or an examination accepted as equivalent there to by the syndicate, subject to such conditions as may be prescribed there to are permitted to appear and qualify for the **B.Sc., Microbiology** degree examination of this University after a course of study of three academic years.

DURATION OF THE PROGRAMME

The course shall extend over a period of three years comprising of six semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

MAXIMUM DURATION FOR THE COMPLETION OF THE UG PROGRAMME

The maximum duration for completion of the UG Programme shall not exceed twelve semesters.

B.Sc., Microbiology (Students admitted from 2023 – 2024 onwards)
SCHEME OF EXAMINATION

Subject Code	Subject	Hrs of Instruction	Exam Duration (Hrs)	Max Marks			Credits Points
				CA	CE	Total	
FIRST SEMESTER							
Part I							
23UTAL101/ 23UHIL101/ 23UFRL101	Tamil I /Hindi I/ French I	5	3	25	75	100	3
Part II							
23UENL101	General English I	5	3	25	75	100	3
Part III							
23UMBM101	DSC I: Fundamentals of Microbiology and Microbial Diversity	6	3	25	75	100	5
23UMBA101	GEC I: Basic and Clinical Biochemistry	4	3	25	75	100	3
23UMBMP101	DSC Practical I	6	6	40	60	100	5
Part IV							
23UMBNM101	SEC I : Social and Preventive Medicine	2	3	25	75	100	2
23UMBSB101	SEC II : Introduction to Microbial World	2	3	25	75	100	2
Total		30				700	23
SECOND SEMESTER							
Part I							
23UTALA201/ 23UHILA201/ 23UFRLA201	Tamil II /Hindi II/ French II	5	3	25	75	100	3
Part II							
23UENLA201	General English II	5	3	25	75	100	3
Part III							
23UMBM201	DSC II: Microbial Physiology and Metabolism	6	3	25	75	100	5
23UMBA201	GEC II: Bioinstrumentation	4	3	25	75	100	3
23UMBMP201	DSC Practical II	6	6	40	60	100	5
Part IV							
23UMBNM201	SEC I :Nutrition and Health Hygiene	2	3	25	75	100	2
23UMBSB201	SEC II : Entrepreneurial Microbiology	2	3	25	75	100	2
Total		30				700	23

THIRD SEMESTER							
Part I							
23UTAL301/ 23UHIL301/ 23UFRL301	Tamil III/ Hindi III/ French III	4	3	25	75	100	3
Part II							
23UENL301	General English III	4	3	25	75	100	3
Part III							
23UMBM301	DSC III: Molecular Biology and Microbial Genetics	5	3	25	75	100	4
23UMAMBA301	GEC III: Biostatistics	4	3	25	75	100	2
23UMBMP301	DSC Practical III	6	6	40	60	100	4
23UMAMBAP301	GEC Practical III: Statistics (Using MS -Excel)	2	3	40	60	100	2
Part IV							
23UMBSB301	SEC II: Calculation for Biology(100% Internal)	2	3	100	-	100	2
23UVE301	AECC : Environmental Studies	2	3	25	75	100	2
Non Credit							
23ULS301	NCC: Career Competency Skills-I	1	-	-	-	-	-
	Total	30				900	25
FOURTH SEMESTER							
Part I							
23UTAL401/ 23UHIL401/ 23UFRL401	Tamil IV/ Hindi IV/ French IV	4	3	25	75	100	3
Part II							
23UENL401	General English IV	4	3	25	75	100	3
Part III							
23UMBM401	DSC IV: Immunology	6	5	25	75	100	5
23UCSMBA401	GEC IV: Introduction to Python and Artificial Intelligence	4	3	25	75	100	2
23UMBMP401	DSC Practical IV	5	5	40	60	100	4
23UCSMBAP401	GEC Practical IV: Python and Office Automation Lab	2	3	40	60	100	2
Part IV							

B.Sc., Microbiology (Students admitted from 2023 – 2024 onwards)

23UMBSB401	SEC II: Clinical Laboratory Technology (100% Internal)	2	3	100	-	100	2
23UVE401	AECC : Yoga	2	3	25	75	100	2
Non Credit							
23ULS401	NCC: Career Competency Skills-II	1	-	-	-	-	-
	Total	30				800	23
FIFTH SEMESTER							
Part III							
23UMBM501	DSC V: Fundamentals of Virology	5	3	25	75	100	4
23UMBM502	DSC VI: Environmental Microbiology	5	3	25	75	100	3
23UMBM503	DSC VII: Soil and Agricultural Microbiology	5	3	25	75	100	3
23UMBM504	DSC VIII : Medical Bacteriology	5	3	25	75	100	4
	DSE: Elective I	4	3	25	75	100	3
23UMBMP501	DSC Practical V	5	6	40	60	100	3
23UMBI501	Internship	-	-	-	-	-	2
Part V							
23UMBE501	Extension Activity	-	-	-	-	-	2
Non Credit							
23ULS501	NCC: Career Competency Skills-III	1	-	-	-	-	-
	Total	30				600	24
SIXTH SEMESTER							
Part III							
23UMBM601	DSC IX: Fermentation Technology	5	3	25	75	100	4
23UMBM602	DSC X: Genetic Engineering	5	3	25	75	100	4
23UMBM603	DSC XI: Food and Dairy Microbiology	5	3	25	75	100	4
	DSE: Elective II	4	3	25	75	100	4
23UMBMP601	DSC Practical VI	5	3	40	60	100	4
23UMBPR601	Project Work	5		40	60	100	4
Non Credit							

23ULS601	NCC: Career Competency Skills-IV	1	-	-	-	-	-
	Total	30				700	24

- DSC** - Discipline Specific Course
GEC - Generic Elective Course
DSE - Discipline Specific Elective
AECC - Ability Enhancement Compulsory Courses
NCC - Non-Credit Courses
ACC - Additional Credit Courses

DSE SUBJECTS

The students shall choose any one of the following elective subjects in fifth and sixth semester.

S.No.	SUBJECT CODE	SUBJECT
1.	23UMBEL501	DSE I: Medical Mycology and Parasitology
	23UMBEL502	DSE I: Cell Biology
2.	23UMBEL601	DSE II: Pharmaceutical Microbiology
	23UMBEL602	DSE II: Microbiology for Social welfare

SKILL ENHANCEMENT COURSES (SEC)

Skill Enhancement Course is conducted for the Students of other Departments

Course Code	Subject	Semester
23UMBNM101	SEC I : Personal Hygiene	I
23UMBNM201	SEC I : Nutrition and Health Hygiene	II

***ADDITIONAL CREDIT COURSES (ACC):**

S.No	Semester IV &V	
1.	*Additional Credit Courses (ACC) - ALC, MOOC Courses offered in SWAYAM/ NPTEL/ CEC etc.,	Completed students can get extra credits

1. Advanced Learner Course:

Course Code	Subject	Semester
23UMBAL401	ACC I : Biofertilizer Technology	IV
23UMBAL501	ACC I : Marine Microbiology	V

1. MOOC Courses offered in SWAYAM/ NPTEL / CEC etc.,

FOR COURSE COMPLETION

Students shall complete

- Language subjects (Tamil / Hindi / French, English) in I, II, III and IV semester.
- Ability Enhancement Course : Environmental Studies and Yoga and in III and IV semester respectively.
- Generic Elective Course (GEC) in I, II, III and IV semester.
- Skill Enhancement Course I in I and II semesters.
- Skill Enhancement Course II in I, II, III and IV semesters.
- Extension activity and internship in the V semester.
- Discipline Specific Elective Courses in the V and VI semesters.
- Project and Viva voce in the VI semester.
- Non Credit Course in the semester III, IV, V and VI.

TOTAL MARKS AND CREDITS DISTRIBUTION

S.No.	PART	MARKS	No. OF CREDITS
1	PART I: Language I	400	12
2	PART II: Language II	400	12
3	PART III : DSC, GEC and DSE	2700	100
4	PART IV: AEC I, AEC II-, SEC I, SEC II	800	16
5	PART V: Extension Activity	-	02
TOTAL		4300	142

ADDITIONAL CREDIT COURSE (ACC)

NPTEL : National Programme on Technology Enhance Learning

SWAYAM : Study Webs of Active-Learning for Young Aspiring Minds

CEC : Consortium for Educational Communication

Others : Elsevier Researcher Academy, Coursera, Edex, Udacity,Udemy& etc.,

23UTAL101	பொதுத்தமிழ் - I	பருவம் -I	
<p>இப்பாடத்திட்டத்தின் நோக்கங்களாவன</p> <ul style="list-style-type: none"> • தமிழ்மொழி இலக்கியங்களை அறிமுகம் செய்தல் • தற்கால இலக்கியப் போக்குகளையும் இலக்கணங்களையும் மாணவர் அறியுமாறு செய்து அவர்களின் படைப்பாற்றலைத் தூண்டுதல் • தமிழ் இலக்கியம் சார்ந்த போட்டித் தேர்வுகளுக்கு ஏற்பகற்பித்தல் நடைமுறைகளை மேற்கொள்ளுதல். 			
Credits:3		Total hrs:50	
UNIT	CONTENTS	Hrs	CO
I	<p>மரபுக் கவிதை</p> <ol style="list-style-type: none"> 1.பெ.சுந்தரனார் –தமிழ்த் தெய்வவணக்கம் 2.பாரதிதாசன் - சிறுத்தையே வெளியில் வா 3.கவிமணி –புத்தரும் சிறுவனும் 4.முடியரசன் - மொழிஉணர்ச்சி 5.கண்ணதாசன் - ஆட்டனத்தி ஆதிமந்தி-ஆதிமந்திபுலம்பல் 6.சுரதா-துறைமுகம் (வினாத்தாள்) 7.தமிழ் ஒளி- கடல் 	10	CO1
II	<p>புதுக்கவிதை</p> <ol style="list-style-type: none"> 1.அப்துல் ரகுமான் - வீட்டுக்கொருமரம் வளர்ப்போம் 2.ஈரோடு தமிழன்பன் - சென்றியூ கவிதைகள் (1.கல்லூரியிலிருந்து- ப.15, 2.சிலைக்கு வெளியே-ப.40, 3.அயர்ந்த தூக்கத்தில்-ப.55, 4.தொட்டிமீன்-ப.86, 5.தண்டனைகளை வைத்து-ப.100) (மேற்கண்டதொடங்கும் கவிதைகள்). 3.வைரமுத்து –பிற்சேர்க்கை 4.மு.மேத்தா –வாழைமரம் 5.அறிவுமதி –வள்ளுவம் பத்து 6.நா.முத்துக்குமார் –ஆனந்தயாழைமீட்டுகிறாய் 7.சுகிர்தராணி –சபிக்கப்பட்டமுத்தம் 8.இளம்பிறை –நீளமுதமுக்கும் எனது அழகு 	10	CO2

<p>III</p>	<p>சிறுகதைகள் 1.வாய்ச் சொற்கள் - ஜெயகாந்தன் (மாலையக்கம் தொகுப்பு) 2.கடிதம் - புதுமைப்பித்தன் 3.கரு -உமாமகேஸ்வரி 4.முள்முடி -தி.ஜானகிராமன் 5.சிதறல்கள் - விழி.பா.இதயவேந்தன் 6.காகித உறவு-ச.சமுத்திரம் 7.வீட்டின் மூலையில் சமையல் அறை-அம்பை 8.(மொழிபெயர்ப்புக் கதை) ஆண்டன் செக்காவ் - நாயக்காரச் சீமாட்டி, சந்தியாபதிப்பகம்.</p>	<p>10</p>	<p>CO3</p>
<p>IV</p>	<p>இலக்கியவரலாறு (பல்லவர்காலம்,நாயக்கர்காலம்) 1.20-ம் நூற்றாண்டுகவிஞர் பெருமக்கள் 2.கவிதையின் வகையும்,வளர்ச்சியும் 3.தமிழ் உரைநடையின் தோற்றமும் வளர்ச்சியும் 4.தமிழ்ச் சிறுகதையின் தோற்றமும் வளர்ச்சியும் 5.மொழிபெயர்ப்புகள் தோற்றமும் வளர்ச்சியும்</p>	<p>10</p>	<p>CO4</p>
<p>V</p>	<p>மொழித்திறன் போட்டித் தேர்வு 1.பொருள் பொதிந்தசொற்றொடர் அமைத்தல் 2.ஓர் எழுத்து ஒரு மொழி 3.வேற்றுமை உருபுகள் 4.திணை,பால்,எண், இடம் 5.கலைச்சொல்லாக்கம்,மொழிபெயர்ப்பு</p>	<p>10</p>	<p>CO5</p>
<p>பாடநூல்</p>	<p>1.தமிழ் இலக்கியவரலாறு-சிற்.பி.பாலசுப்பிரமணியன் 2.புதிய நோக்கில் தமிழ் இலக்கியவரலாறு-தமிழண்ணல் 3.வகைமைநோக்கில் தமிழ் இலக்கியவரலாறு-முனைவர் பாக்கியமேரி.</p>		

COURSE OUTCOMES(CO)

இப்பாடத்தைக் கற்பதன் வாயிலாகமாணவர்கள் பெறும் பயன்களாவன:

<p>CO1</p>	<p>பாரதியார் காலந்தொட்டுதற்காலப் புதுக்கவிதைகள் வரைகவிதை இலக்கியம் அறிமுகப்படுத்தப்படுவதால் படைப்பாற்றல் திறன் பெறுதல்.</p>
<p>CO2</p>	<p>புதுக்கவிதை வரலாற்றினை அறிந்துகொள்வர்.</p>
<p>CO3</p>	<p>இக்கால இலக்கியவகையினைக் கற்பதன் மூலம் படைப்பாக்கத் திறனைப் பெறுவர்.</p>
<p>CO4</p>	<p>மொழியறிவோடு சிந்தனைத்திறன் அதிகரித்தல்.</p>
<p>CO5</p>	<p>தமிழ்மொழியைப் பிழையின்றி எழுதவும், புதியகலைச் சொற்களை உருவாக்கவும் அறிந்துகொள்ளுதல்.</p>

23UENL101	GENERAL ENGLISH I	SEMESTER – I	
COURSE OBJECTIVES: The course aims <ul style="list-style-type: none"> • To enable learners to acquire the linguistic competence necessarily required in various life situations. • To help them understand the written text and able to use skimming, scanning skills. • To assist them in creative thinking abilities. • To enable them become better readers and writers • To assist them in developing correct reading habits, silently, extensively and intensively 			
Credits: 3		Total Hours: 50	
UNI T	CONTENTS	Hrs	CO
I	Poetry 1.1 A Patch of Land – Subramania Bharati 1.2 The Sparrow - Paul Laurence Dunbar 1.3 A Nation’s Strength - Ralph Waldo Emerson 1.4 Love Cycle- Chinua Achebe	10	CO1
II	Prose 2.1 JR-Harish Bhat 2.2 Us and Them -David Sedari 2.3 From Dress Your Family in Corduroy and Denim – David Sedari 2.4 Uncle Podger Hangs a Picture- Jerome K Jerome	10	CO2
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	10	CO3
IV	Language Competency 4.1 Vocabulary: Synonyms, Antonyms, Word Formation 4.2 Appropriate use of Articles and Parts of Speech 4.3 Error correction	10	CO4
V	English for Work place 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	10	CO5
TEXT BOOK:			
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
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WEB RESOURCES

1.	A patch of land by Subramania Bharati translated by Usha Rajagopalan : 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
6.	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.h
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

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.VijayKumar, K Durga Bhavani, YL Srinivas
2	Practical English Usage- 4 th 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.

23UMBM101	DSC I: FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY	SEMESTER I	
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> To learn about the early developments of Microbiology. To learn the classification and taxonomic groups of microbes. To learn the microscopy and other basic laboratory techniques– culturing, disinfection and sterilization in Microbiology. 			
Credits: 05		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
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, Archaeobacteria and Eucarya. Conservation of Biodiversity.	10	CO1
II	General characteristics of microorganisms : cellular - (Bacteria, Algae, Fungi and Protozoa) and acellular - (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.	10	CO2
III	Bacterial culture media and pure culture techniques: Mode of cell division, Quantitative measurement of growth. Anaerobic culture techniques.	10	CO3
IV	Microscopy: Simple, bright field, dark field, phase contrast, fluorescent, electron microscope–TEM & SEM, Confocal microscopy and Atomic Force Microscopy. Stains and staining methods.	10	CO4
V	Sterilization: moist heat - autoclaving, dry heat -Hot air oven,	10	CO5

	radiation - UV, Ionization, filtration-membrane filter and disinfection, antiseptic; Antimicrobial agents.		
Text Book:			
1.	Pelczar. M. J., Chan E. C. S. and Noel. R. K. (2007). Microbiology. 7 th Edition., McGraw-Hill, NewYork.		
2.	Willey J., Sherwood L., and Woolverton C J., (2017). Prescott's Microbiology. 10 th Edition., McGraw- Hill International edition.		
3.	Tortora, G. J., Funke, B. R., Case, C .L. (2013). Microbiology. An Introduction 11 th Edition., A La Carte Pearson.		
4.	Salle. A. J (1992). Fundamental Principles of Bacteriology. 7 th Edition., McGraw Hill Inc. NewYork.		
5.	Boyd, R.F. (1998). General Microbiology, 2 nd Edition., Times Mirror, Mosby College Publishing, St Louis.		
Reference Books:			
1.	Jeffrey C. Pommer ville., Alcamo's Fundamentals of Microbiology (9 th Edition). Jones & Bartlett learning 2010.		
2.	Stanier R. Y, Ingraham J. L., Wheelis M. L., and Painter R. R. (2010). General Microbiology, 5 th Edition., Mac Millan Press Ltd		
3.	Tortora, G. J., Funke, B.R. and, Case, C.L (2013). Microbiology - An Introduction, 11 th Edition., Benjamin Cummings.		
4.	Nester E., Anderson D., Roberts C. E., and Nester M. (2006). Microbiology-A Human Perspective, 5 th Edition., Mc Graw Hill Publications.		
5.	Madigan M. T., Martinko J.M., Stahl D. A, and Clark D. P. (2010). Brock –Biology of Microorganisms, 13 th 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 .

COURSE OUTCOMES (CO)

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

CO 1	Learn the fundamental principles about different aspects of Microbiology including recent developments in the area.
CO 2	Describe the structural organization, morphology and reproduction of microbes.
CO 3	Explain the methods of cultivation of microbes and measurement of growth.
CO 4	Understand the microscopy and other basic laboratory techniques—culturing, disinfection and sterilization in Microbiology.
CO 5	Compare and contrast the different methods of sterilization.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	H	M	M	M	M	H	M	M
CO2	H	H	H	H	M	H	H	H	H	M
CO3	H	H	H	H	M	H	H	H	H	M
CO4	M	H	M	H	H	M	H	M	H	H
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBA101	GEC I: BASIC AND CLINICAL BIOCHEMISTRY	SEMESTER I	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To learn the structure, classification, biochemical functions and significance of carbohydrates and lipids. To discuss and evaluate the pathology of amino acid metabolic disorders. 			
Credits: 03		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Biomolecules: Carbohydrate- General properties, function, structure, classification- monosaccharides (Glucose, Fructose, Galactose), Oligosaccharides (Sucrose, Maltose, Lactose) and polysaccharides (Starch, Glycogen,) and biological significance. Lipids - General properties, functions, structure, classification (Simple, Derived and Complex), Cholesterol, LDL, HDL-biological significance.	10	CO1
II	Biomolecules: Amino acids - General properties, functions, structure, classification and biological significance. Proteins- General structure, Properties, functions, classification and biological significance.	10	CO2
III	Disorders of Metabolism: Disorders of carbohydrate metabolism: diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia and lactose intolerance. Disorders of lipid metabolism: hyperlipidemia, hyperlipoproteinemia, hypercholesterolemia, hypertriglyceridemia, sphingolipidosis.	10	CO3
IV	Disorders of Metabolism: Disorders of amino acid metabolism: alkaptonuria, phenyl ketonuria, phenyl alaninemia, homocystineuria, tyrosinemia, aminoacidurias. Stains and staining methods.	10	CO4
V	Evaluation of organ function tests: Assessment and clinical manifestations o renal, hepatic, pancreatic, gastric and intestinal	10	CO5

	functions. Diagnostic enzymes: Principles of diagnostic enzymology. Clinical significance of aspartate aminotransferase, alanine amino transferase, creatine kinase, aldolase and lactate dehydrogenase.		
Text Book:			
1	Satyanarayana, U. and Chakrapani, U (2014).Biochemistry, 4 th Edition, Made Simple Publisher.		
2	Jain J L, Sunjay Jain and Nitin Jain (2016).Fundamentals of Biochemistry, 7 th Edition,S Chand Company.		
3	Ambika Shanmugam's (2016). Fundamentals of Biochemistry for Medical Students, 8 th Edition. Wolters Kluwer India Pvt Ltd.		
4	Vasudevan. D. M. Sreekumari. S, Kannan Vaidyanathan (2019). Textbook of Biochemistry.		
5	Jeremy M. Berg, Lubert Stryer, John L. Tymoczko, Gregory J. Gatto (2015). Biochemistry, 8 th edition. WH Free man publisher.		
Reference Books:			
1.	Amit Kessel & Nir Ben-Tal (2018). Introduction to Proteins: structure, function and motion. 2 nd Edition, Chapman and Hall.		
2.	David L. Nelson and Michael M. Cox (2017). Lehninger Principles of Biochemistry, 7 th Edition W. H. Freeman and Co., NY.		
3.	Lupert Styrrer, Jeremy M. Berg, John L. Tymaczko, Gatto Jr., Gregory J (2019). Biochemistry. 9 th Edition, W. H. Freeman & Co. NewYork.		
4.	Donald Voet, Judith Voet, Charlotte Pratt (2016). Fundamentals of Biochemistry: Life at the Molecular Level, 5 th Edition, Wiley.		
5.	Joy P P, Surya S. and Aswathy C (2015). Laboratory Manual of Biochemistry, Edition1., 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
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COURSE OUTCOMES (CO)

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

CO1	Explain the structure, classification, biochemical functions and significance of carbohydrates and lipids.
CO2	Differentiate essential and non-essential aminoacids, biologically important modified aminoacids and their functions, Illustrate the role, classification of Proteins and recognize the structural level organization of proteins, its functions and denaturation.
CO3	Assess defective enzymes and Inborn errors. Recognize diseases related to carbohydrate and lipid metabolism.
CO4	Discuss and evaluate the pathology of amino acid metabolic disorders.
CO5	Appraise the imbalances of enzymes in organ function and relate the role of Clinical Biochemistry in screening and diagnosis.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	H	M	H	M	M	H	M	M
CO2	H	H	H	H	H	H	H	H	H	M
CO3	H	M	H	H	M	H	M	H	H	M
CO4	M	H	M	H	H	M	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBMP101	DSC PRACTICAL I: FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY	SEMESTER I	
Course Objectives: The course aims <ul style="list-style-type: none"> • To learn the basic techniques of Microbiology. • To understand the morphological structures of bacteria. • To cultivate and maintain the microorganisms. 			
Credits: 05		Total Hours: 60	
Experiment	CONTENTS	Hrs	CO
1.	Handling, maintenance and care of bright field Microscope, Cleaning of glassware	3	CO1
2.	Staining techniques- Simple staining	3	CO1
3.	Gram's staining.	3	CO1
4.	Acid Fast (Ziehl- Neelson) staining	3	CO1
5.	Spore staining	3	CO1
6.	Capsular staining	3	CO1
7.	Media preparation- Liquid media- Nutrient broth, Solid media- Nutrient agar	6	CO2
8.	Preparation of agar slants and agar deeps.	6	CO2
9.	Pure culture techniques- Serial dilution method and pour plate method	6	CO3
10.	Streak plate method	6	CO3
11.	Spread plate method	6	CO3
12.	Stab culture method	6	CO4
13.	Antibiotic sensitivity test- Kirby-Bauer disc diffusion method	6	CO5

Reference Books:	
1.	<i>Cappucino, J. Gand Sherman, N.</i> 2012. Microbiology - A laboratory manual. [Seventh Edition]. Pearson Education Inc.
2.	Harley and Prescott. 2002. Laboratory Exercises in Microbiology, [Fifth Edition]. McGraw Hill Companies.
3.	<i>Kannan, N.</i> Laboratory manual in General Microbiology. [Second Edition]. Panimapublishing corporation, New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Identify microbes through staining with microscopy.
CO2	Design different media for cultivation of microorganisms.
CO3	Evaluate the isolation and purification of microorganisms.
CO4	Demonstrate the maintenance of bacterial cultures.
CO5	Evaluate control measures of microorganisms using chemotherapy.

23UMBNM101	SEC I : SOCIAL AND PREVENTIVE MEDICINE	SEMESTER I	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To learn about the various health care services. To outline the goals of preventive medicine. 			
Credits: 02		Total Hours: 25	
UNIT	CONTENTS	Hrs	CO
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.	5	CO1
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.	5	CO2
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.	5	CO3
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- fore casting and control measures in community setting-early detection methods.	5	CO4
V	Prevention through alternate medicine: Unani, Ayurveda, Homeopathy, Naturopathy systems in epidemic and pandemic	5	CO5

	outbreaks. International health regulations. Infectious disease outbreak case studies and precautionary response during SARS and MERS corona virus, Ebola and novel SARS- COV2 outbreaks.		
Text Book:			
1.	Park. K (2021). Text book of preventive and social medicine, 26 th edition. Banarsidas Bhanot publishers.		
2.	Mahajan & Gupta (2013). Text book of preventive and social medicine, 4 th edition. Jaypee brothers medical publishers.		
3.	Chun- Su Yuan, EricJ.Bieber, Brent Bauer (2006). Text book of Complementary and Alternative Medicine. Second Edition. Routledge publishers.		
4.	Vivek Jain (2020). Review of Preventive and Social Medicine: Including Biostatistics. 12 th edition, Jaypee Brothers Medical Publishers.		
5.	Lal Adarsh Pankaj Sunder (2011). Textbook of Community Medicine: Preventive and Social Medicine, CBS publisher.		
Reference 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. Davids on, Robert M. Kaplan (2010). Hand book of Health Psychology and Behavioral Medicine. Guilford Press.		
4.	Marie Eloise Muller, Marie Muller, Marthie Bezuidenhout, Karien Jooste (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

COURSE OUTCOMES (CO)

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

CO1	Identify the health information system
CO2	Associate various factors with health management system
CO3	Choose the appropriate health care services
CO4	Appraise the role of preventive medicine in community setting
CO5	Recommend the usage of alternate medicine during outbreaks

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	H	M	H	M	M	H	M	M
CO2	H	M	H	M	M	H	M	M	H	M
CO3	H	M	H	M	M	H	M	H	H	M
CO4	M	H	M	M	H	M	H	H	H	H
CO5	H	H	H	M	H	H	H	H	H	H

H - High; M- Medium; L - Low

23UMBSB101	SEC II : INTRODUCTION TO MICROBIAL WORD	SEMESTER I	
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> To emphasize economic importance of bacteria. To gain knowledge on beneficial and harmful aspects of fungi. 			
Credits: 02		Total Hours: 25	
UNIT	CONTENTS	Hrs	CO
I	<p>General features and economic importance of bacteria- General characteristics and morphology of bacteria, mycoplasma, and archaeobacteria. Economic importance of bacteria with examples in antibiotic production (<i>Streptomyces</i>), biofertilizer (<i>Rhizobium</i>), superbugs (<i>Pseudomonas</i>), fermentation (<i>Lactobacillus</i>). Harmful aspects such as food spoilage (<i>Clostridium</i>) and diseases (<i>Xanthomonas</i>, <i>Salmonella</i>, <i>Vibrio</i>).</p>	5	CO1
II	<p>General features and economic importance of fungi- General characteristics and morphology of fungi, Economic importance of fungi with examples in biopesticide (<i>Beauveria</i>), industry (<i>Saccharomyces</i>), medicine (<i>Penicillium</i>). Harmful aspects-food spoilage (mold), diseases in crops (<i>Fusarium</i>), humans (<i>Aspergillus</i>), allergic reactions (<i>Mucor</i>).</p>	5	CO2
III	<p>General features and economic importance of algae- General characteristics and morphology of algae. Beneficial aspects of algae with examples in single cell protein (<i>Spirulina</i>), soil fertility (<i>Anabaena</i>), environment (Phytoplanktons). Harmful aspects-Eutrophication and phycotoxins.</p>	5	CO3
IV	<p>General features and economic importance of virus- General characteristics of virus. Economic importance of virus with examples in vaccine production (Rabies virus), gene therapy (Adenovirus), biopesticides (Cauliflower mosaic virus). Harmful aspects- diseases (plant- TMV, human- Influenza virus).</p>	5	CO4
V	<p>General features and economic importance of protozoa- General</p>	5	CO5

	characteristics of protozoa. Beneficial applications of protozoa with examples- Biocontrol (<i>Haemogregarina</i>), sanitation (<i>Amoeba</i>), oil exploration (<i>Radiolaria</i>). Harmful aspects- diseases (<i>Entamoeba</i> , <i>Giardia</i>).		
Text Book:			
1.	Pelczar, M. J., Chan, E. C. S. and Kreig, N. R. (2006). Microbiology. 5 th edition, Tata McGraw Hill Inc, New York.		
2.	Dubey, R. C. and Maheswari, D. K. (2005). A Textbook of Microbiology. S. Chand & Company Ltd, New Delhi.		
3.	Subba Rao, N.S. (1995). Soil microorganisms and plant growth ,Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.		
Reference Books:			
1.	Hurst, C. J., Crawford, R. L., Garland, J. L., Lipson, D. A. and Mills, A. L. (2002). Manual of Environmental Microbiology, 2nd Edition.		
2.	Atlas, R. A. (1995). Principles of Microbiology. Mosby Publications, USA.		
3.	Madigan, M. T. and Martinko, J.M. (2014). Brock Biology of Microorganisms. 1 4 th Edition. Prentice Hall International Inc., USA.		
WebResources			
1	https://microbiologyinfo.com/category/basic-microbiology/		
2	https://microbiologyinfo.com/category/basic-microbiology/		
3	https://www.britannica.com/science/microbiology		

COURSE OUTCOMES (CO)

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

CO1	Emphasize economic importance of bacteria.
CO2	Gain knowledge on beneficial and harmful aspects of fungi.
CO3	Explore the role of algae in various sectors.
CO4	Acquire basic insight on significance of viruses.
CO5	Impart importance of protozoa in day-to-day life

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	H	M	H	M	M	H	M	M
CO2	H	M	H	M	M	H	M	M	H	M
CO3	H	M	H	M	M	H	M	H	H	M
CO4	M	H	M	M	H	M	H	H	H	H
CO5	H	H	H	M	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UTAL201	பொதுத்தமிழ் - II	பருவம் -II	
<p>இப்பாடத்திட்டத்தின் நோக்கங்களாவன</p> <ul style="list-style-type: none"> சமய இலக்கியங்களையும் சிற்றிலக்கியங்களையும் மாணவர்களுக்கு அறிமுகப்படுத்துதல். மொழித்திறனையும் சிறுகதை இலக்கியவடிவத்தையும் மாணவர்க்கு உணர்த்துதல். 			
Credits: 03		Total Hrs:50	
UNIT	CONTENTS	Hrs	CO
I	<p>பக்தி இலக்கியம்</p> <p>1.திருநாவுக்கரசர் தேவாரம் - நாமாக்கும் குடியல்லோம் எனத் தொடங்கும் பதிகம் (10 பாடல்கள்)</p> <p>2.ஆண்டாள் - திருப்பாவை (முதல் 10 பாசரம்)</p>	10	CO1
II	<p>பிற்பக்தி இலக்கியங்கள்</p> <p>1.வள்ளலார் –அருள் விளக்கமாலை (முதல் 10 பாடல்கள்)</p> <p>2.எச்.ஏ.கிருட்டிணப்பிள்ளை - இரட்சணியமனோகரம் - பால்யபிரார்த்தனை</p> <p>3.குணங்குடி மஸ்தான் சாகிபு-பராபரக்கண்ணி (முதல் 10 கண்ணி)</p>	10	CO2
III	<p>சிற்றிலக்கியங்கள்</p> <p>1.தமிழ்விடு தூது (முதல் 20கண்ணி)</p> <p>2.திருக்குற்றாலக் குறவஞ்சி-குறத்திமலைவளம் கூறுதல்</p> <p>3.முக்கூடல் பள்ளு-நாட்டு வளம்</p>	10	CO3
IV	<p>இலக்கியவரலாறு (பல்லவர்காலம்,நாயக்கர்காலம்)</p> <p>1.பன்னிரு திருமுறைகள்</p> <p>2.நாலாயிரத் திவ்வியப் பிரபந்தம்</p> <p>3.திருமடங்களின் தமிழ்ப்பணி</p> <p>4.சிற்றிலக்கியங்கள்</p> <p>5.சைவ சித்தாந்தசாத்திரங்கள்</p>	10	CO4
V	<p>மொழித்திறன் போட்டித் தேர்வு</p> <p>1.தொடர் வகைகள்</p> <p>2.மரபுத்தொடர்,பழமொழிகள்</p> <p>3.பிறமொழிச் சொற்களைக் களைதல்</p> <p>4.வழுஉச்சொற்கள் நீக்குதல்</p> <p>5.இலக்கணக் குறிப்புஅறிதல்</p>	10	CO5
பாடநூல்	<p>1. தமிழ் இலக்கியவரலாறு- சிற்பி .பாலசுப்பிரமணியன், மணமலர் பதிப்பகம், சென்னை. பதிப்பு: இருபத்திஏழாம் பதிப்பு -1998</p> <p>2. புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு- தமிழண்ணல், மீனாட்சி புத்தக நிலையம், மதுரை. பதிப்பு: முப்பத்திஆறாம் பதிப்பு,ஆகஸ்ட் ,2017</p> <p>3. வகைமை நோக்கில் தமிழ் இலக்கிய வரலாறு- முனைவர்பாக்கியமேரி, பாரிநிலையம்,</p>		

சென்னை.

COURSE OUTCOMES(CO)

இப்பாடத்தைக் கற்பதன் வாயிலாகமாணவர்கள் பெறும் பயன்களாவன:

CO1	பக்தி இலக்கியங்களைக் கற்பதன் மூலம் பக்திநெறியினையும்,சமயநல்லிணக்கத்தையும் தெரிந்துபின்பற்றுவர்.
CO2	சிற்றிலக்கியங்களின் வழி இலக்கியச் சுவையினையும் பண்பாட்டுஅறிவினையும் பெறுதல்.
CO3	பட்டப் படிப்பினைப் படிக்கும்போதேபெரும்பான்மையானதமிழ் இலக்கியங்கள் குறித்தஅறிவினைப் பெறுவர்.
CO4	தமிழ்ச் சமூகப் பண்பாட்டுவரலாற்றினை இலக்கியங்கள் வாயிலாகஅறிவர்.
CO5	போட்டித் தேர்வுகளில் வெற்றிபெறுவதற்குத் தமிழ்ப் பாடத்தினைப் பயன்கொள்ளும் வகையில் ஏற்றபயிற்சி பெறுவர்.

23UENL201	GENERAL ENGLISH II	SEMESTER - II	
Course Objectives: <ul style="list-style-type: none"> • To enable the students to develop their comprehensive skill. • To make the students to know about Communication skills. • To make the students to practice the forms and functions of Grammar and Vocabulary. 			
Credits: 3		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	<p>Unit I</p> <p>1.Listening :</p> <p style="padding-left: 20px;">a. Listening & responding to complaints b. Listening to problem & offering solution</p> <p>2.Speaking:</p> <p style="padding-left: 20px;">a. Opening conversation b. Turn taking c. Closing conversation</p> <p>3.Reading:</p> <p style="padding-left: 20px;">a. Types of Reading</p> <p style="padding-left: 40px;">i. Intensive reading</p> <p>ii. Extensive reading</p> <p>4.Writing:</p> <p style="padding-left: 20px;">a. Effective use of SMS b. E-mail message</p> <p>5.Grammar in Context & Vocabulary:</p> <p style="padding-left: 20px;">a. Regular & irregular verbs b. Tenses</p> <p>Vocabulary:</p> <p style="padding-left: 20px;">a. Homophones</p> <p>b. Homonyms</p>	10	CO1
II	<p>Unit II</p> <p>1.Listening :</p> <p style="padding-left: 20px;">a. Listening to Mass Media Documentaries</p> <p>2.Speaking:</p> <p style="padding-left: 20px;">a. Asking Directions b. Giving Directions</p> <p>3.Reading:</p>	10	CO2

	<p>a. Reading Newspaper Article b. Reading a Short Story c. Reading Comprehension</p> <p>4.Writing: a. Writing a Review b. Report Writing</p> <p>5.Grammar in Context & Vocabulary: a. Types of Sentence & Sentence Pattern Vocabulary: Commonly Mispelt words</p>		
III	<p>Unit III</p> <p>1.Listening : a. Tonal Variation</p> <p>2.Speaking: a. Conversation Skill of Stress, Intonation, Pronunciation and Meaning</p> <p>3.Reading: a. Speed Reading : Skimming</p> <p>4.Writing: a. Writing Instructions b. Drafting Forms(Aadhar Enrolment Update form and Postal form)</p> <p>5.Grammar in Context & Vocabulary: Voice (Active and Passive) Vocabulary: American English, British English</p>	10	CO3
IV	<p>Unit IV</p> <p>1.Listening : a. Telephonic Conversation b. Telephonic Etiquette</p> <p>2.Speaking: a. Interview skills - Mock Interview b. Role play</p> <p>3.Reading: a. Scanning: Job Advertisement</p> <p>4.Writing: a. Job Cover Letter b. Resume</p>	10	CO4

	<p>5.Grammar in Context & Vocabulary: Numerical Adjectives Vocabulary: Abbreviations & Acronyms</p>		
V	<p>Unit V 1.Listening : a. Listening to TED Talks 2.Speaking: a. Group Discussion b. Types of Group Discussion 3.Reading: a. Note-Taking 4.Writing: a. Precise Writing b. Transcoding – interpretation of charts, maps, graphs, pie chart and bar charts 5.Grammar in Context & Vocabulary: Gerunds & Infinitives Vocabulary: Word Formation – Prefix & Suffix Compound Words</p>	10	CO5

REFERENCE BOOKS

1	Hewings Martin,2013, <i>Advanced Grammar in Use</i>
2	Anderson chris, 2000, <i>TED Talks: The Official TED Guide to Public Speaking</i>
3	Piankova Tamara, 2014, <i>The Pronunciation of English: A Reference and Practice Book</i>
4	<i>Practical English Usage</i> by Michael Swan, Oxford University Press – 2016.
5	<i>English Language Communication Skills – Lab Manual cum Workbook</i> , Cengage learning India Pvt Limited

COURSE OUTCOMES (CO)

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

CO1	Understand and apply the Fundamentals of Communication Skills in their communication skills.
CO2	Identify the nuances of Language skills.
CO3	To impart basic English grammar and essentials of language skills as per present requirement
CO4	Understand and use all types of English vocabulary and language proficiency.
CO5	Adopt the Techniques of Interview and Professional skills.

23UMBM201	DSC II: MICROBIAL PHYSIOLOGY AND METABOLISM	SEMESTER II	
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> • To study the basic principles of microbial growth • To understand the basic concepts of aerobic and anaerobic metabolic pathways. • To provide information on sources of energy and its utilization by microorganisms. 			
Credits: 05		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Physiology of microbial growth: Batch- continuous- synchronous cultures; Growth Curve and measurement method (turbidity, biomass, and cell count). Control of microbial growth.	10	CO1
II	Nutrition requirement: Photoautotrophs, Photoorganotrophs, Chemolithotrophs (Ammonia, Nitrite, Sulfur, Hydrogen, Iron oxidizing Bacteria), Chemoorganotrophs. Nutrition transport mechanisms-Passive diffusion and Active transport. Factors affecting microbial growth.	10	CO2
III	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	10	CO3
IV	Photosynthesis : An Overview of chloroplast structure. Photosynthetic Pigments, Light Reaction- Cyclic and non- cyclic Photophosphorylation. Dark Reaction - Calvin Cycle.	10	CO4
V	Bacterial reproduction: Binary fission, Budding, Reproduction through conidia, cyst formation, endospore formation. Fungi asexual and sexual reproduction, Micro algae reproduction.	10	CO5
Text Book:			

1.	Schlegel , H. G.(1993). General Microbiology., 7 th Edition, Press syndicate of the University of Cambridge.
2.	Rajapandian K. (2010). Microbial Physiology, Chennai: PBS Book Enterprises India.
3.	Meena Kumari. S. Microbial Physiology, Chennai 1 st Edition MJP Publishers 2006.
4.	Dubey R. C. and Maheswari, S (2003). A text book of Microbiology, New Delhi: S. Chand & Co.
5.	S. Ram Reddy,S .M. Reddy (2008). Microbial Physiology .Anmol Publications Pvt Ltd.
Reference 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. Gand J. W Foaster (1995). Microbial Physiology, 3 rd edition. Wiley-LISS, A John Wiley & Sons. Inc.Publications.
5.	Bhanu Shrivastava. (2011). Microbial Physiology and Metabolism: Study of Microbial Physiology and Metabolism. Lambert academic Publication.
Web Resources	
1.	https://sites.google.com/site/microbialphysiologyoddsem/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

COURSE OUTCOMES (CO)

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

CO1	Describe microorganisms based on nutrition.
CO2	Know the concept of microbial growth and identify the factors affecting bacterial growth.
CO3	Explain the methods of nutrient uptake.
CO4	Describe anaerobic and aerobic energy production.
CO5	Elaborate on the process of bacterial photosynthesis and reproduction.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	H	M	M
CO2	H	H	M	H	M	H	M	H	H	M
CO3	H	H	M	H	M	H	M	H	H	M
CO4	M	H	M	H	H	M	M	M	H	H
CO5	H	H	M	H	H	H	M	H	H	H
H - High; M- Medium; L - Low										

23UMBA201	GEC II: BIOINSTRUMENTATION	SEMESTER II	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To understand the analytical instruments and study the basic principles in the field of sciences. To gain knowledge about principles of spectroscopy To understand the analytical techniques of Chromatography and electrophoresis, principle of different types of scans, radioactivity and its measurements 			
Credits: 03		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Basic instruments: pH meter, Laminar Air Flow, and Incubator. Centrifuge- principles and application (Preparative and Analytical). Instrumentation (low speed, high speed and ultra). Care and types of rotors.	10	CO1
II	Spectroscopic Techniques: Spectrophotometry- Principles, instrumentation and applications - Ultraviolet and visible, Colorimeter.	10	CO2
III	Chromatographic and Electrophoresis Techniques: Chromatographic Techniques: Paper, Thin Layer, Column, HPLC, GC and ion exchange chromatography. Electrophoresis Techniques: Discontinuous gel electrophoresis- SDS PAGE.	10	CO3
IV	Imaging techniques: Principle, Instrumentation and application of ECG, EEG, EMG, MRI, and CT.	10	CO4
V	Radioactivity: Radioisotopes, disintegration constant, half life and units of radioactivity. Detection and measurement of radio activity- Scintillation counter, Geiger Muller counter, Autoradiography.	10	CO5
Text Book:			

1.	Jayaraman J (2011). Laboratory Manual in Biochemistry, 2 nd Edition. Wiley Eastern Ltd., New Delhi.
2.	Ponmurugan. P and Gangathara PB (2012). Biotechniques. 1 st Edition. MJP publishers.
3.	Veerakumari, L (2009). Bioinstrumentation- 5 th Edition -. MJP publishers.
4.	Upadhyay, Upadhyay and Nath (2002). Biophysical chemistry– Principles and techniques 3 rd Edition. Himalaya publishing home.
5.	Chatwal Gand Anand (1989). Instrumental Methods of Chemical Analysis. S. Himalaya Publishing House, Mumbai.

Reference Books:

1.	Rodney. F. Boyer (2000). Modern Experimental Biochemistry, 3 rd Edition. Pearson Publication.
2.	Skoog A., West M (2014). Principles of Instrumental analysis – 14 th Edition W. B. Saunders Co., Philadelphia.
3.	N. Gurumani. (2006). Research Methodology for biological sciences- 1 st Edition- MJP Publishers.
4.	Wilson K, and Walker J (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7 th Edition. Cambridge University Press
5.	Webster, J. G. (2004). Bioinstrumentation - 4 th Edition-John Wiley & Sons (Asia) Pvt. Ltd, Singapore.

Web Resources

1.	http://www.biologydiscussion.com/biochemistry/centrifugation/centrifuge-introduction-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/Page 24 of75
4.	https://study.com/academy/lesson/what-is-chromatography-definition-typesuses.html

5.	http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction
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COURSE OUTCOMES (CO)

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

CO1	Gain knowledge about the basics of instrumentation.
CO2	Exemplify the structure of atoms and molecules by using the Principles of spectroscopy.
CO3	Evaluate by separating and purifying the components.
CO4	Understand the need and applications of imaging techniques.
CO5	Categorize the working principle and applications of fluorescence and radiation.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	H	M	M
CO2	H	H	M	H	M	H	M	H	H	M
CO3	H	H	M	H	M	H	M	H	H	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBMP201	DSC PRACTICAL II : MICROBIAL PHYSIOLOGY AND METABOLISM	SEMESTER II	
Course Objectives: The course aims <ul style="list-style-type: none"> • To learn about the morphological diversity of microorganisms. • To understand the biochemical characterization of microorganisms. 			
Credits: 05		Total Hours: 48	
Experiment	CONTENTS	Hrs	CO
1.	Measurement of cell size- Micrometry	3	CO1
2.	Motility of bacteria - Hanging drop method	3	CO1
3.	Growth curve -Turbidity method	6	CO1
4.	IMViC tests	3	CO2
5.	Sugar fermentation tests	3	CO2
6.	Triple sugar iron agar (TSI) test	3	CO3
7.	Catalase and Oxidase tests	3	CO3
8.	Urease test	3	CO3
9.	Anaerobic culture method	3	CO3
10.	Effect of various factors on growth of bacteria i. Temperature ii. pH iii. Nutrients - carbon source	6	CO4
11.	Thermal Death Point and Thermal Death Time	6	CO4
12.	Microscopic examination of cyanobacteria - <i>Oscillatoria</i> sp., <i>Spirulina</i> sp., <i>Nostoc</i> sp. and <i>Anabaena</i> sp.	3	CO5
13.	Microscopic examination of fungi - <i>Mucor</i> sp., <i>Aspergillus</i> sp., <i>Penicillium</i> sp. and <i>Alternaria</i> sp.	3	CO5

Reference Books	
1.	<i>Harley Prescott. Laboratory Exercises in Microbiology.</i> [Fifth Edition]. The McGraw-Hill companies.
2.	<i>Kannan, N. Laboratory Manual in General Microbiology.</i> [Second Edition]. Panima publishing corporation, New Delhi.
3.	<i>Benson. 2001. Microbiological Applications Laboratory Manual in General Microbiology.</i> [Eighth Edition]. The McGraw-Hill Companies.

EXPERIMENT OUTCOMES (EO)	
After the completion of this course, the students will be able to	
CO1	Identify the motility of bacteria and determine the size of bacteria.
CO2	Analyze the different phases of bacterial growth
CO3	Outline the characterization of bacteria based on biochemical activities.
CO4	Assess the bacterial growth based on environmental factors.
CO5	Discriminate the structures of Algae and Fungi.

23UMBNM201	SEC I: NUTRITION AND HEALTH HYGIENE	SEMESTER II	
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> To learn about nutrition, nutritional facts and their importance To learn information to optimize our diet To impart knowledge on different health care programs taken up by India and types of hygiene methods 			
Credits: 02		Total Hours: 25	
UNIT	CONTENTS	Hrs	CO
I	<p>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.</p>	05	CO1
II	<p>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.</p>	05	CO2
III	<p>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.</p>	05	CO3
IV	<p>Health: Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health</p>	05	CO4

	Organizations: Health Indicators and National Health Policy of Govt. of India; Functioning of various nutrition and health organizations in India.		
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.	05	CO5
Text Book:			
1.	Bamji, M. S., K. Krishnaswamy & G. N. V. Brahman (2009) Text book of Human Nutrition (3 rd 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.	S K. 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		
Reference Books:			
1.	Vijaya Khader (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 Text book of Health & Hygiene, ABD Publishers		
4.	Sharma D. (2015). Text book on Food Science and Human Nutrition. Daya Publishing House.		
	Revilla M .K. F., Titchenal A. and Draper J. (2020). Human Nutrition. University of Hawaii, Mānoa.		

5.	
WebResources	
1	National Rural Health Scheme: https://nhm.gov.in/index1.php?ang=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

COURSE OUTCOMES (CO)

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

CO1	Learn the importance of nutrition for a healthy life
CO2	Study the nutrition for life cycle
CO3	Know the health care programmes of India
CO4	Learn the importance of community and personal health & hygiene measures
CO5	Create awareness on community health and hygiene

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	H	M	M
CO2	H	H	M	H	M	H	M	H	H	M
CO3	M	M	M	M	M	M	M	M	M	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBSB201	SEC II : ENTREPRENEURIAL MICROBIOLOGY	SEMESTER II	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To learn information to become an entrepreneur. To impart knowledge on microbiological role in industries and agriculture. To learn about the significance of Patenting. 			
Credits: 02		Total Hours: 25	
UNIT	CONTENTS	Hrs	CO
I	Entrepreneur development activity - Institutes involved, Government contributions to entrepreneurs, risk assessment. Industrial Microbiology, Definition, scope.	05	CO1
II	Microbial cells as fermentation products - Baker's yeast, food and feed yeasts, Bacterial Insecticides (<i>Bacillus thuringiensis</i>), Legume Inoculants (<i>Rhizobium</i>).	05	CO2
III	Mushroom cultivation and Composting - Cultivation of <i>Agaricus campestris</i> and <i>Volvariella volvaciae</i> ; Preparation of compost, filling tray beds, spawning, maintaining optimal temperature, casing, watering, harvesting, storage.	05	CO3
IV	SCP-Economic importance and nutritive value of Spirulina and Mass Cultivation. Biofertilizer- Azolla - Mass cultivation and its applications.	05	CO4
V	Patents and secret processes - patenting, composition, subject matter and characteristics of a patent, Inventor, Infringement, cost of patent - Patents in India and other countries.	05	CO5
Text Book:			
1.	Entrepreneurial Development in India- By Arora.		
2.	Sathyanarayana. U, Biotechnology. (2005) 1stEd. Books and Allied (P) Ltd.		

Reference Books:	
1.	Casida, L E JR, (2019). Industrial Microbiology. New Age International Publishers
2.	K.R.Aneja, Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom production technology, 6thEd.S Chand Publication.
3.	A.H. Patel. Industrial Microbiology.2016. 2ndEd. Laxmi Publications, New Delhi.
4.	Dubey R C. A Textbook of Biotechnology. (2014). S Chand Publishers.

COURSE OUTCOMES (CO)

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

CO1	Learn information to become an entrepreneur.
CO2	Understand the importance of fermentation products.
CO3	Discuss the economic importance of mushroom and its cultivation.
CO4	Learn the importance of single cell protein and its nutritive value.
CO5	Demonstrate the importance of patenting.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	H	M	M
CO2	H	H	M	H	M	H	M	H	H	M
CO3	M	M	M	M	M	M	M	M	M	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H

H - High; M- Medium; L - Low

23UTAL301	பொதுத்தமிழ் - III	பருவம் - III	
இப்பாடத்திட்டத்தின் நோக்கங்களாவன <ul style="list-style-type: none"> • சமயங்கள் பற்றி அறிமுகம் செய்தல் • சமய இலக்கியங்கள் பற்றி மாணவர் அறியுமாறு செய்தல் • பிறநீதி இலக்கியங்கள் மூலம் மாணவர்களுக்கு அறத்தினை வலியுறுத்துதல் 			
Credits:3		Total hrs:50	
UNIT	CONTENTS	Hrs	CO
I	சைவம், வைணம் அ) திருஞானசம்பந்தர் - கோளறுபதிகம் ஆ) குலசேகராழ்வார் - பெருமாள் திருமொழி- திருப்பதியில் பிறக்க அவாவுறுதல்.	10	CO1
II	கிருத்துவ இஸ்லாமிய இலக்கியங்கள் அ) கண்ணாதசன் - இயேசுகாவியம் -சிலுவைபாடு (முதல் 10 பாடல்) ஆ) சீராப்புராணம் - நடுவத்துக்காண்டம் - மானுக்குப்பிள்ளைநின்றபடலம்	10	CO2
III	பிறநீதி இலக்கியங்கள் அ) கொன்றைவேந்தர் - முதல் 20 பாடல்கள் ஆ) வெற்றிவேற்கை-முதல் 20 பாடல்கள் இ) நீதிநெறிவிளக்கம் - முதல் 5 பாடல்கள் ஈ) உலகநீதி - முதல் 5 பாடல்கள் உ)முதுரை -முதல் 5 பாடல்கள்	10	CO3
IV	சமய இலக்கிய வரலாறு அ) சைவம் தோற்றம் வளர்ச்சி ஆ) வைணவம் தோற்றம் வளர்ச்சி இ) கிறித்துவதோற்றம் வளர்ச்சி ஈ) இஸ்லாம் தோற்றம் வளர்ச்சி உ)பிற்காலநீதி இலக்கியங்கள் அறிமுகம்	10	CO4

V	<p>இலக்கணம்</p> <p>அ) அணியிலக்கணம்</p> <ol style="list-style-type: none"> 1. தற்குறிப்பேற்றஅணி 2. உவமையணி 3. பின்வருநிலையணி 4. உருவகஅணி 5. வஞ்சபுகழ்ச்சியணி 6. உயர்வுநவிற்சியணி 7. நிரல்நிறையணி 8. இரட்டுறமொழிதல் அணி <p>ஆ) மொழிப்பெயர்ப்பு (ஆங்கிலம் - தமிழ்)</p>	10	CO5
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பாடநூல்

1.தமிழ்த்துறை வெளியீடு

பார்வை நூல்கள்

த.கோ.வேந்தன், நாலாயிரதிவ்யபிரபந்தம், சாரதா பதிப்பகம், சென்னை, 2017

தமிழண்ணல், புதிய நோக்கில் தமிழ் இலக்கிய வரலாறு, மீனாட்சி புத்தகநிலையம், மதுரை- 2017.

தண்டியலங்காரம், கழகவெளியீடு.

COURSE OUTCOMES(CO)

இப்பாடத்தைக் கற்பதன் வாயிலாகமாணவர்கள் பெறும் பயன்களாவன:

CO1	பக்தி இலக்கியங்கள், மொழிவளர்ச்சிக்கு உதவியதைக் கூறுதல்.
CO2	சமய இலக்கியங்கள் பற்றி அறிதல்
CO3	நீதி இலக்கியங்கள் வழி அறத்தை வலியுறுத்துதல்
CO4	சமய இலக்கியங்கள் தோற்றம் வளர்ச்சியை அறிதல்.
CO5	மொழியின் அடிப்படை இலக்கணத்தை அறிதல்.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	H	H	H	H	H	H	H	M	M	M
CO2	H	L	L	L	L	L	H	M	M	M
CO3	H	H	H	H	H	H	H	M	M	M
CO4	H	M	M	M	M	M	H	M	M	M
CO5	H	H	H	H	H	H	H	M	M	M

H - High; M- Medium; L - Low

23UENL301	GENERAL ENGLISH- III	SEMESTER - III	
<p>Course Objectives:</p> <p>The Course aims to,</p> <ul style="list-style-type: none"> • Communicate in simple and routine tasks on familiar topics and activities • Understand the importance of listening and practice effective listening. • Use grammar effectively for accuracy in writing and speaking. • Use relevant vocabulary in everyday communication 			
Credit: 3		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	<p>1. Listening: Listening to basic conversations and instructions.</p> <p>2. Speaking: Role play-Seeking and sharing information</p> <p>3. Reading: Critical reading</p> <p>4. Writing: Extended Definitions, Dialogue writing, Film/Book review</p> <p>5. Grammar: Who- questions, Question Tag. Punctuation</p> <p>6. Vocabulary: Business Jargon (Synonyms & Antonyms)</p>	10	CO1
II	<p>1. Listening: Listening to advertisements and brief Documentary films(with subtitles)</p> <p>2. Speaking: Brainstorming (mind mapping) Small group discussions (subject- specific)</p> <p>3. Reading: Reading visual texts – Advertisements</p> <p>4. Writing: Advertisement Writing, Blog Writing.</p> <p>5. Grammar: Concord</p> <p>6. Vocabulary: Word formation using Prefixes</p>	10	CO2
III	<p>1. Listening : Listening to interviews</p> <p>2. Speaking: Small Talks, Non-Technical presentation</p> <p>3. Reading: Short passage.</p> <p>4. Writing: Creative writing, Process description.</p> <p>5. Grammar: Conditional Clauses</p>	10	CO3

	6.Vocabulary: – Portmanteau Words		
IV	<p>1.Listening : Listening to TED talks.</p> <p>2. Speaking: Giving ideas and opinions during the meeting and making concluding remarks.</p> <p>3.Reading:Reading a biography (eminent speakers and writers)</p> <p>4. Writing: Hints development, Check list.</p> <p>5.Grammar :Reported speech</p> <p>6.Vocabulary: Idioms and Phrasal Verbs.</p>	10	CO4
V	<p>1.Listening : Listening to presentation. Listening to lectures. Watching- documentaries (discovery/history channel)</p> <p>2.Speaking: Polite form of long sentences (Can-do Statements) Making formal presentations (PPT)</p> <p>3. Reading: Reading to identify point of view and perspective (opinion pieces, editorials etc.)</p> <p>4.Writing: Narrative writing – writing narrative essays of two to three paragraphs</p> <p>5.Grammar: Simple, Compound and Complex sentences</p> <p>6.Vocabulary: Discourse Markers</p>	10	CO5
Text Book:			
A Textbook of English Language Communication Skills, Infinite Learning Solutions– (Revised Edition) 2021.			
Technical Communication by Gajendra Singh Chauhan and Et al, Cengage learning India Pvt Limited [Latest Revised Edition] – 2019			
Reference Books:			
1.	Communication Skills by Sanjay Kumar and Pushp Lata, Oxford University Press - 2019. 2) 4) A Course in Technical English–D Praveen Sam, KN Shoba, Cambridge University Press – 2020..		
2.	English for Engineers by N.P.Sudharshana and C.Savitha, Cambridge University Press – 2018. 3)		

3.	Reading Skills: How to Read Better and Faster- Speed Reading, Reading Comprehension & Accelerated Learning (2nd Edition), Nick Bell.
4.	English Vocabulary in Use: Upper Intermediate, Cambridge University Press.
Web Resources	
1.	https://learnenglish.britishcouncil.org/skills/listening/a2-listening/four-conversations
2.	https://www.csuohio.edu/writing-center/critical-reading-what-critical-reading-and-why-do-i-need-do-
3.	https://learnenglish.britishcouncil.org/grammar/b1-b2-grammar/reported-speech-statements
4.	https://www.youtube.com/watch?v=TdWcUi4RjtA
5.	https://hbr.org/2013/06/how-to-give-a-killer-presentation

COURSE OUTCOMES (CO)

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

CO1	Recall key vocabulary words, grammar rules, and language structures.
CO2	Interpret the meaning of texts, including implicit and explicit information.
CO3	Apply grammar rules and vocabulary knowledge to create sentences and express ideas accurately.
CO4	Analyze the structure and organization of texts, identifying elements such as main ideas, supporting details, and transitions.
CO5	Evaluate the effectiveness of communication strategies in different contexts.

23UMBM301	DSC III: MOLECULAR BIOLOGY AND MICROBIAL GENETICS	SEMESTER III	
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> • To provide knowledge on structure and replication of DNA. • To understand the significance and functions of RNA in protein synthesis. • To provide information about the mechanisms of gene transfer and recombination. 			
Credits: 04		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	<p>DNA Replication: DNA Structure - Salient features of double helix, forms of DNA. Denaturation and renaturation. DNA topology - Supercoiling, linking number, topoisomerases. DNA organization in prokaryotes. Replication of DNA in prokaryotes - 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.</p>	10	CO1
II	<p>Transcription in Prokaryotes: Concept of transcription. RNA Polymerases - prokaryotes. Distinction between transcription processes in prokaryotes versus eukaryotes. Translation in prokaryotes - Translational machinery - ribosome structure in prokaryotes, tRNA structure and processing. Inhibitors of protein synthesis in Prokaryotes. Overview of regulation of gene expression - <i>lac</i>, <i>trp</i> operons as examples. Regulation of gene expression by DNA methylation.</p>	10	CO2
III	<p>Mutation: - Definition and types - base substitutions, frame shifts, deletions, insertions, duplications, inversions. Silent, conditional, and lethal mutations. Physical and chemical mutagens. Uses of mutations. Repair Mechanisms - Photoreactivation, Nucleotide Repair, Base Excision Repair, Methyl Directed Mismatch Repair</p>	10	CO3

	and SOS Repair.		
IV	Gene Transfer Mechanisms: Conjugation and its uses. Transduction - Generalized and Specialized, Transformation - Natural Competence and Transformation.	10	CO4
V	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.	10	CO5
Text Book:			
1.	Malacinski G.M. (2008). Freifelder's Essentials of Molecular Biology. 4 th Edition. Narosa Publishing House, New Delhi.		
2.	Gardner E. J. Simmons M. J. and Snusted D.P. (2006). Principles of Genetics. 8 th Edition. Wiley India Pvt. Ltd.		
3.	Trun N. and Trempey J. (2009). Fundamental Bacterial Genetics. 1 st Edition. Blackwell Science Ltd.		
4.	Brown T. A. (2016). Gene Cloning and DNA Analysis- An Introduction. (7 th 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. (3 rd Edition). John Wileys and Sons Ltd.		
Reference Books:			
1.	Glick B. R. and Patten C.L. (2018). Molecular Biotechnology – Principles and Applications of Recombinant DNA. 5 th Edition. ASM Press.		
2.	Russell P.J. (2010). iGenetics - A Molecular Approach, 3 rd Edition., Pearson New International edn.		
3.	Nelson, D.L. and Cox, M.M. Lehninger (2017). Principles of Biochemistry. 7 th Edition, W.H. Freeman.		
4.	Synder L., Peters J. E., Henkin T.M. and Champness W. (2013). Molecular Genetics of Bacteria, 4 th Edition, ASM Press Washington-D.C. ASM Press.		

5.	Primrose S.B. and Twyman R. M. (2006). Principles of Gene Manipulation and Genomics. (7 th Edition). Blackwell Publishing
Web Resources	
1.	[PDF] Lehninger Principles of Biochemistry (8th Edition) By David L. Nelson and Michael M. Cox Book Free Download – Study Materialz.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

COURSE OUTCOMES (CO)

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

CO1	Analyze the significance of DNA and elucidate the replication mechanism.
CO2	Illustrate the types of RNA and protein synthesis machinery.
CO3	Infer the causes and types of DNA mutation and summarize the DNA repair mechanisms.
CO4	Evaluate the importance of plasmids and phages in genetics.
CO5	Analyze gene transfer and recombination methods.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	H	M	M	M	M	M	M
CO2	H	H	M	H	M	H	M	M	H	M
CO3	H	H	M	H	M	H	M	M	H	M
CO4	M	H	M	H	H	M	M	M	H	H
CO5	H	H	M	H	H	H	M	M	H	H
H - High; M- Medium; L - Low										

23UMAMBA301	GEC III: BIostatistics	SEMESTER-III	
COURSE OBJECTIVE:			
The Course aims			
<ul style="list-style-type: none"> To understand the concept of statistical measures in descriptive statistics. To understand the concept of test of significance. 			
Credits: 2		Total Hours: 40	
UNIT	CONTENTS	Hrs	CO
I	Introduction: Definition –Functions of Statistics –Limitations of Statistics – Collection of data – Classification and Tabulation. (Chapter 1 Sections: 1.3, 1.7, 1.8) (Chapter 2 Sections: 2.1, 2.3)	08	CO1
II	Measures of Central Tendency: Arithmetic Mean– Median– Mode – Geometric mean – Harmonic mean. (Chapter 3 Sections: 3.1.1, 3.2-3.5)	08	CO2
III	Measures of Dispersion and Variability: Range – Inter Quartile Range and Quartile Deviation – Mean Deviation – Standard deviation – Coefficient of variation. (Chapter 4 Sections: 4.1 – 4.4)	08	CO3
IV	Correlation Analysis: Types of correlation– Methods of studying Correlation (Excluding Correlation of grouped data). Regression Analysis: Regression line–Regression equation (Excluding Method of Least Square). (Chapter 6 Sections: 6.1 – 6.2) (Chapter 7 Sections: 7.1 – 7.2)	08	CO4
V	Sampling and Tests of Significance: Steps in test of hypothesis – Test of significance of small samples (t and F) – Chi-square test and Goodness of Fit. (Problems only). (Chapter 10 Sections: 10.1, 10.6) (Chapter 11)	08	CO5
Text Book:			
1.	<i>Palanichamy. S and Manoharan. M, 2003 Statistical methods for Biologists. [Third Edition]. Palani Paramount Publications, Palani.</i>		

Reference Books:	
1.	<i>Daniel W. W.</i> 2013. Biostatistics . John Wiley and Sons, New york.
2.	<i>Arora, P. N. and Malhan, P. K.</i> 2010 Biostatistics . Himalaya Publishing House, Mumbai.

COURSE OUTCOMES (CO)

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

CO1	Learn the importance of statistics
CO2	Understand the concepts of measures of central tendency
CO3	Know the concepts of measures of dispersion
CO4	Gain knowledge on correlation and regression analyses
CO5	Test the samples using testing of hypothesis

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	H	M	M	L	L	H	H	H	H	H
CO2	H	H	H	L	M	H	H	H	L	H
CO3	M	H	H	M	M	H	H	H	H	L
CO4	L	L	M	H	H	H	H	H	L	H
CO5	L	M	M	H	H	H	L	H	H	H

H - High; M- Medium; L - Low

23UMBMP301	DSC PRACTICAL III	SEMESTER III	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To learn about the methods of genomic and plasmid DNA isolation. To understand the methods of protein separation. 			
Credits: 04		Total Hours: 48	
Experiment	CONTENTS	Hrs	CO
1.	Isolation of genomic DNA from E.coli	6	CO1
2.	Isolation of plasmid DNA from E.coli	6	CO1
3.	Estimation of DNA using diphenylamine method	3	CO2
4.	SDS -PAGE	6	CO2
5.	Spontaneous mutation – isolation of auxotrophic mutant by gradient plate method.	6	CO3
6.	Induced mutation – isolation of auxotrophic mutant by replica plate method	6	CO3
7.	Estimation of RNA by orcinol method.	3	CO4
8.	Bacterial conjugation.	6	CO5
9.	Estimation of protein by Lowry method.	6	CO5

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

EXPERIMENT OUTCOMES (EO)	
After the completion of this course, the students will be able to	
CO1	Illustrate different types of DNA and RNA.
CO2	Utilize hands-on training in isolation of genomic and plasmid DNA.
CO3	Analyze importance of experimental microbial genetics.
CO4	Apply the knowledge of molecular techniques in various fields.
CO5	Investigate the significance of various estimation methods.

23UMAMBAP301	GEC PRACTICAL III: STATISTICS (USING MS-EXCEL)	SEMESTER-III	
COURSE OBJECTIVE:			
The Course aims			
<ul style="list-style-type: none"> To give a good grip on concepts in analyzing the data using statistical software. 			
Credits: 2		Total Hours: 21	
PROGRAM	CONTENTS	Hrs.	CO
1	Diagrams and graphs	03	CO1
2	Measures of Locations	03	CO2
3	Measures of Dispersion	03	CO2
4	Correlation coefficient (Karl Pearson and Rank method)	03	CO3
5	Regression lines	03	CO3
6	Small sample test (t and F)	03	CO4
7	Chi-square test for independence of attributes.	03	CO4
REFERENCE BOOKS			
1.	<i>Bhattacharjee Dibyojyoti. Practical Statistics Using Microsoft Excel.</i> Asian Books Private Ltd.		
2.	<i>Apte D. P. 2008. Statistical Tools for Manger susing MS EXCEL.</i> Excel Books.		

COURSE OUTCOMES (CO)

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

CO1	Demonstrate the data in diagrammatic and graphical representation
CO2	Find the averages and measures of dispersion
CO3	Calculate correlation and regression for huge amount of data
CO4	Gain knowledge about test of significance

23UMBSB301	SEC II: CALCULATION FOR BIOLOGY	SEMESTER III	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To make the students to understand the basic calculations in Microbiology. To study various analytical techniques in the field of Microbiology. 			
Credits: 02		Total Hours: 25	
UNIT	CONTENTS	Hrs	CO
I	Unit of Measurement: SI units. Strength of the solutions - Percentage solutions, part solutions, molar solutions and normal solutions.	05	CO1
II	Buffers: pH and pka calculations, preparation of buffers - phosphate buffer , bicarbonate buffer, acetate buffer.	05	CO2
III	Cell growth: Bacterial growth curve - Manipulating cell concentration, linear graph, Calculating generation time, Measuring cell concentrations on hemocytometer.	05	CO3
IV	Quantification of Nucleic acid and proteins: Quantification of Nucleic acid by spectrometry - ds DNA, ss DNA, RNA. Quantification of protein by measuring at 280 nm. Quantitating protein at A280 in nucleic acid contamination.	05	CO4
V	Centrifugation: Relative centrifugal force (g force), converting g force to RPM, calculating sediment times.	05	CO5
Text Books:			
1.	<i>Frank H. stephenson</i> , 2016. Calculations for Molecular Biology and Biotechnology - Academic press.		

COURSE OUTCOMES (CO)

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

CO1	Prepare solutions and buffers for performing laboratory experiments.
CO2	Calculate the optimum concentrations of solutes to be mixed for preparing solutions.
CO3	Interpret the mechanism of bacterial cell growth.
CO4	Develop the skill to quantitate the biological macromolecules.
CO5	Apply the knowledge of centrifugation.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	H	H	H	H	H	H	H	H	H	H
CO2	M	M	M	H	H	M	M	M	H	H
CO3	H	H	H	H	M	H	H	H	H	M
CO4	M	H	H	H	M	M	H	H	H	M
CO5	M	M	M	M	M	M	M	M	M	M
H - High; M- Medium; L - Low										

23UVE301	AECC : ENVIRONMENTAL STUDIES	SEMESTER - III	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To enable the students acquire knowledge, values, attitudes, commitment and skills needed to protect and improve the environment. To implicate awareness among young minds for safeguarding environment from manmade disasters. 			
Credits: 2		Total Hours: 30	
UNIT	CONTENTS	Hrs	CO
I	Environment - Definition - Scope - Structure and function of ecosystems - producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession- food chain, food webs and ecological pyramids - Concept of sustainable development.	06	CO1
II	Natural resources: Renewable - air, water, soil, land and wildlife resources. Non-renewable - Mineral coal, oil and gas. Environmental problems related to the extraction and use of natural resources.	06	CO2
III	Biodiversity - Definition - Values - Consumption use, productive social, ethical, aesthetic and option values threats to bio diversity - hotspots of bio diversity - conservation of bio- diversity: in - situ Ex - situ. Bio - wealth - National and Global level.	06	CO3
IV	Environmental Pollution: Definition - causes, effects and mitigation measures - Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution - Nuclear hazards - Solid wastes acid rain - Climate change and global warming environmental laws and regulations in India - Earth summit	06	CO4
V	Population and environment - Population explosion - Environment and human health - HIV/AIDS - Women and Child	06	CO5

	welfare – Disaster Management - Resettlement and Rehabilitation of people, Role of information technology in environmental health – Environmental awareness.		
Text Book			
1. Department of Biochemistry. Environmental Studies (Study Material). Published by K. S. Rangasamy College of Arts & Science (Autonomous). Tiruchengode.			
Reference Book			
1. Erach Bharucha. 2005. Textbook of Environmental studies . Universities press. PVT. Ltd.			

COURSE OUTCOMES (CO)

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

CO1	Describe the types of ecosystem and concepts in sustainable development
CO2	Explain the importance of natural resources
CO3	Recite about the biodiversity, hot spots of biodiversity and its Conservation
CO4	Be conscious on the effects of pollution and global warming
CO5	Implement the preventive measures for environmental issues

23ULS301	NCC: CAREER COMPETENCY SKILLS - I	SEMESTER - III	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To understand the basic needs of Communication To utilize the communication skills for achieving at the time of Interview 			
Total Hours: 15			
UNIT	CONTENTS	Hrs	CO
I	Tenses, concord, sentence pattern.	3	CO1
II	Communication effectiveness, Personal skills, Presentation & public speaking	3	CO2
III	Resume writing, formal letter (sending Invitation/accepting Invitation/declining invitation/permission letter)	3	CO3
IV	Professional Skills(leadership skills, Emotional Intelligence (EI & EQ), Negotiating, Delegation)	3	CO4
V	Group Discussion, Interview Skills, Mock GD & Interview	3	CO5
Text Book:			
1.	<i>Basic English Grammar for English-Book 1, Learners, Anne Seaton, Y.H. Mew, Saddle point Publishers(E-Copy)</i>		
2.	<i>Basic English Syntax with Exercises, Mark Newson (E-Copy)</i>		
Reference Book:			
1.	<i>Objective General English, S. Chand, Dr. R.S. Agarwal</i>		

COURSE OUTCOMES (CO)

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

CO1	Able to recall the basic grammar in language
CO2	Easy to concentrate on sentence correction
CO3	Preparing for resume building & letter formatting.
CO4	Improving the ability of skill development
CO5	Improving the interview skills.

23UTAL401	பொதுத்தமிழ் - IV	பருவம் - IV	
<p>இப்பாடத்திட்டத்தின் நோக்கங்களாவன</p> <ul style="list-style-type: none"> • சங்க இலக்கியங்களை அறிமுகம் செய்தல். • அற இலக்கியங்கள் பற்றிமாணவர்கள் அறியசெய்தல் • இலக்கிய வரலாறுகளை அறியவைத்தல் 			
Credits: 3		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	<p>சங்க இலக்கியம் (எட்டுத்தொகை)</p> <p>அ) குறுந்தொகை—பாடல் 2,3,4,40,167</p> <p>ஆ) கலித்தொகை—பாடல் 1-15</p> <p>இ) புறநானூறு —பாடல் 3,112</p> <p>ஈ) ஐங்குறுநூறு —வேட்கைப்பத்து (முதல் 15 பாடல்கள்)</p>	10	CO1
II	<p>சங்க இலக்கியம் (பத்துப்பாட்டு)</p> <p>அ) முல்லைப்பாட்டுமுழுவதும் (103 வரிகள்)</p>	10	CO2
III	<p>அற இலக்கியம்</p> <p>அ) திருக்குறள் - விருந்தோம்பல்</p> <p>ஆ) நாலடியார் - கல்வி (முதல் 5 பாடல்கள்)</p> <p>இ) இனியவைநாற்பது—முதல் 5 பாடல்கள்</p> <p>ஈ) முதுமொழிக்காஞ்சி—தண்டாப்பத்து</p>	10	CO3
IV	<p>இலக்கியவரலாறு</p> <p>அ) முச்சங்கவரலாறுஅறிமுகம்</p> <p>ஆ) எட்டுத்தொகை நூல்கள்</p> <p>இ) பத்துப்பாட்டு நூல்கள்</p> <p>ஈ) பதினெண்கீழ்க்கணக்கு நூல்கள்</p>	10	CO4
V	<p>இலக்கணம்</p> <p>அ) வல்லினம் மிகும்மிகா இடங்கள்</p> <p>ஆ) தன்வினை,பிறவினை,செய்வினை,</p>	10	CO5

	செய்பாட்டுவினைவாக்கியங்கள்		
	இ) நேர்காணல்		
பாடநூல்			
1.தமிழ்த்துறை வெளியீடு			
பார்வைநூல்கள்			
ச.வே.சுப்பிரமணியம், பதினென்கீழ்க்கணக்கு நூல்கள், மணிவாசகர் பதிப்பகம், சென்னை, 2012.			
புலியூர் கேசிகள், குறுந்தொகை, சாரதாபதிப்பகம், சென்னை- 2010			
முல்லைப்பாட்டு, மறைமலையடிகள், இராமையாபதிப்பகம், சென்னை-			

COURSE OUTCOMES(CO)

இப்பாடத்தைக் கற்பதன் வாயிலாக மாணவர்கள் பெறும் பயன்களாவன

CO1	எட்டுத்தொகை நூல்கள் பற்றி அறிதல்.
CO2	பத்துப்பாட்டு நூல்கள் பற்றி அறிதல்.
CO3	அற இலக்கியங்கள் வழி வாழ்க்கை கூறுகளை உணர்த்துதல்
CO4	இலக்கியவரலாற்றின் தோற்றம் வளர்ச்சியை அறிதல்
CO5	அடிப்படை இலக்கணத்தை அறிதல்.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	H	H	H	H	H	H	H	M	M	M
CO2	H	H	H	H	H	H	H	M	M	M
CO3	H	L	L	L	L	L	H	M	M	M
CO4	H	M	M	M	M	M	H	M	M	M
CO5	H	H	H	H	H	H	H	M	M	M

H - High; M- Medium; L - Low

23UENL401	GENERAL ENGLISH - IV	SEMESTER - IV	
<p>Course Objectives: The course aims to,</p> <ul style="list-style-type: none"> • Develop the language skills of students by offering adequate practice in professional contexts • To focus on developing students' knowledge of domain specific registers and the required language skills • Impart basic English grammar and essentials of important language skills • To enhance English vocabulary and language proficiency for better communication skills 			
Credits: 3		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	<p>1. Listening: Listening to audio text and answering questions Listening to Instructions</p> <p>2. Speaking: Public speaking, Extempore</p> <p>3. Reading: Comprehension passages –Differentiate between facts and opinion</p> <p>4. Writing: Developing story with pictures.</p> <p>5. Grammar: Prepositions</p> <p>6. Vocabulary: Fixed Expressions</p>	10	CO1
II	<p>1. Listening: Process of communication Barriers to effective communication</p> <p>2. Speaking: Techniques for Neutralization of mother tongue influence</p> <p>3. Reading: News magazines, Reading for unfamiliar words</p> <p>4. Writing: Summary writing, Précis Writing</p> <p>5. Grammar: Common errors (Tenses, Subject-Verb agreement)</p> <p>6. Vocabulary: Compare and Contrast Expressions</p>	10	CO2
III	<p>1. Listening : Listening to Dialects of English – British & American Regional</p>	10	CO3

	<p>2. Speaking: Debate, Persuasive talk.</p> <p>3. Reading: Short narratives and descriptions from newspapers including dialogues and conversations</p> <p>4. Writing : Essay Writing</p> <p>5. Grammar : Mood, Modifiers</p> <p>6. Vocabulary : Changing words from one form to another</p>		
IV	<p>1.Listening : Radio News / TV -News telecast</p> <p>2.Speaking : Watch or Listen to documentaries and ask Questions</p> <p>3.Reading: Reading Motivational Stories(Success stories in subject areas)</p> <p>4.Writing : Business Letters: Calling for Quotation, Complaint & Sales Letter</p> <p>5. Grammar: Negation (Statements & Questions)</p> <p>6. Vocabulary : Sequence of words</p>	10	CO 4
V	<p>1. Listening : Listening to health problems and advice, Stress in responses, Listening to restaurant orders</p> <p>2. Speaking: Expressing Likes and dislikes, Agreeing and disagreeing , Table manners, Ordering a meal</p> <p>3. Reading : Reading about the new hobby of geocaching</p> <p>4. Writing : Meeting Minutes, Memos</p> <p>5. Grammar : Relative clause</p> <p>6. Vocabulary in Context Unlocking the word meanings Directly Unlocking the word meanings Indirectly</p>	10	CO5
Text Book:			
1.	A Textbook of English Language Communication Skills, Infinite Learning Solutions- (Revised Edition) 2021.		
Reference Books:			
1.	Interchange By Jack C. Richards & Jonathan Hull, Cambridge Univ. Press, 2015.		
2.	A Course Book On Technical English By Lakshminarayanan, Scitech Publications		

	(India) Pvt. Ltd
Web Resources	
1.	https://www.fluentu.com/blog/educator-english/esl-listening-websites/
2.	https://americanenglish.state.gov/resources/teachers-corner-listening

COURSE OUTCOMES (CO)

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

CO1	Comprehend and correspond with others in various contexts, effectively exchanging information and ideas through written and spoken communication.
CO2	Speak legibly and fluently in diverse life-time situations by applying appropriate communication modules to convey their thoughts clearly and confidently.
CO3	Understand a variety of writings analyzing both the meaning and language to extract information and gain insights from diverse sources.
CO4	Evaluate their own proficiency level in English language skills, identifying strengths and areas for improvement through self-assessment and reflection.
CO5	Create situational conversations and writing styles for interpersonal and effective communication, adapting language and discourse patterns to suit different contexts and purposes.

23UMBM401	DSC IV: IMMUNOLOGY	SEMESTER IV	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To understand the working of immune system and immune molecules. To know the mechanism of immune response and immunodiagnosis. To impact knowledge on immunological disorders. 			
Credits: 05		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Introduction and Immunity: Basics in Immunology- Contributions-Early theories and clonal selection theory. Immunity types and response- Innate and Acquired immunity, Humoral and Cell mediated immunity.	10	CO1
II	Cells and Organs of Immune System and Antigen: Hematopoiesis and its regulations. Cells, Organs and tissues of the immune system- Primary lymphoid organs- Secondary lymphoid tissues. Antigens: Types- Epitopes, hapten, adjuvants and properties. Super Antigens.	10	CO2
III	Antigen- Antibody Reactions: Antibody: Structure, types and properties. Monoclonal antibody production. Primary and secondary reactions, Chemical interactions, Agglutination, Agglutination inhibition, Precipitation, Immunofluorescence, ELISA, RIA, Complement fixation test, Immunohaematology- ABO and Rh incompatibility.	10	CO3
IV	Complement System: Properties, Classical and alternative pathway, Cytokines structure and functions, MHC and its role. Autoimmunity- Grave's disease, Myasthenia Gravis. Vaccinology - Immunization - Active and Passive- Attenuated vaccine-Recombinant vaccine - purified macromolecules as vaccines. COVID Vaccine	10	CO4

V	Effector Mechanisms: Transplantation- HLA Typing-Types of grafting, graft acceptance and rejection. Hypersensitive reactions- Classification-IgE mediated (type-I)- Antibody mediated cytotoxic (Type-II)- Immune complex mediated (Type-III)- TDTH -Mediated(Type-IV). Cancer immunology- Origin and terminology, Immune responses to tumour, Cancer Immunotherapy.	10	CO5
Text Book:			
1.	<i>Nandhini Shetty.</i> 2021. Immunology: Introductory Text Book. 2 nd edition. New Age International Pvt. Ltd., New Delhi.		
Reference Books:			
1.	<i>Roitt.</i> 2017. Essential Immunology. 13 th Edition. Wiley - Blackwell Scientific Publishers, London.		
2.	<i>Janeway, C. A., P. Travers, M. Walport and M. J. Shlomchik</i> (2008). Immunobiology: 7 th Edition. The Immune System in Health and Disease. Garland Publishing, USA.		
3.	<i>Kuby.</i> 2022. Immunology. eighth Edition. W.H. Freeman and Company, New York.		

COURSE OUTCOMES (CO)

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

CO1	Understand the importance of immunity.
CO2	Discuss the cells and organs of immune system.
CO3	Analyze the importance of immunity and to develop new monoclonal antibodies.
CO4	Demonstrate the nature of antigens and antibodies and to develop vaccines.
CO5	Analyze merits and demerits of transplantation.

MAPPING										
PO & PSO \ CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M	M	M	M	M	M
CO2	H	H	H	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	H	H	H	H
CO4	M	M	M	M	M	M	M	M	M	M
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UCSMBA401	GEC III: INTRODUCTION TO PYTHON AND ARTIFICIAL INTELLIGENCE (For the students of B.Sc. Microbiology)	SEMESTER-IV	
COURSE OBJECTIVES: The course aims <ul style="list-style-type: none"> • To make students understand the concepts of Python programming • To have an introduction about Artificial Intelligence. • To elaborate on future trends of Artificial Intelligence 			
Credit Points: 2		Total Hours: 30	
UNIT	CONTENTS	Hrs	CO
I	Basics of Python Programming: History of Python-Features of Python-Literal-Constants-Variables - Identifiers-Keywods-Built-in Data Types-Output Statements - Input Statements-Comments - Indentation- Operators-Expressions.	6	CO1
II	Control Statements: Selection/Conditional Branching statements: if, if-else, nested if and if-elif-else statements. Iterative Statements: while loop, for loop, else suite in loop and nested loops. Jump Statements: break, continue and pass statements.	6	CO2
III	Functions: Function Definition - Function Call - Variable Scope and its Lifetime-Return Statement. Function Arguments: Required Arguments, Keyword Arguments, Default Arguments and Variable Length Arguments- Recursion.	6	CO3
IV	Introduction: Definitions of Artificial Intelligence - Artificial Intelligence problems - Topics of Artificial Intelligence - Timelines of Artificial Intelligence - Branches of Artificial Intelligence - Applications of Artificial Intelligence.	6	CO4
V	Future of Artificial Intelligence : Autonomous Cars - United States Vs China - Technological Unemployment - Weaponization of AI - Drug Discovery - Artificial General	6	CO5

	Intelligence		
Text Book:			
1.	<i>Reema Thareja, First Edition, 2017. Python Programming using problem solving approach.</i> Oxford University Press.(UNIT I,II,III)		
2.	<i>Vinod Chandra S.S and Haseendran.S , 2014. Artificial Intelligence and Machine Learning,</i> Prentice Hall of India Pvt Ltd, Delhi.(UNIT IV)		
3.	<i>Tom Taulli, 2019. Artificial Intelligence Basics – A Non-Technical Introduction,</i> A Press. Edition Ltd, New Delhi. (UNIT V)		
Reference Books:			
1.	<i>John Paul Mueller, Luca Massaron, Artificial Intelligence For Dummies</i> [Second Edition].2007. DreamtechPress,New Delhi.		
WEB REFERENCES:			
1.	https://medium.com/@manutej/a-non-technical-introduction-to-ai-part-1-a53471fae2fe		
2.	https://www.netguru.com/blog/crash-course-introduction-to-ai-fundamentals		

COURSE OUTCOMES (CO)

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

CO1	Understand the basics concepts of python.
CO2	Working with Looping and jump statements.
CO3	Learn the Concept of function and function arguments
CO4	Understand the basics of Artificial Intelligence.
CO5	Discuss about the Future of Artificial Intelligence.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	M	M	M	H	M	M	M	M
CO2	H	M	M	M	M	H	M	M	M	M
CO3	H	H	M	M	M	H	H	M	M	M
CO4	H	H	M	H	M	H	H	M	H	M
CO5	H	H	H	H	H	H	H	M	H	M

H - High; M- Medium; L - Low

23UMBMP401	DSC PRACTICAL IV	SEMESTER IV	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To study the serological diagnostic techniques. To study the qualitative analysis of various antigen against antibody. 			
Credits: 04		Total Hours: 36	
Experiment	CONTENTS	Hrs	CO
1.	ABO blood grouping and cross matching	3	CO1
2.	CRP	3	CO2
3.	RA	3	CO2
4.	ASO	3	CO3
5.	RPR	3	CO2
6.	WIDAL test (Slide and tube methods)	6	CO3
7.	Haemagglutination	3	CO4
8.	Tridot ELISA	3	CO4
9.	Counter Immunoelectrophoresis	3	CO5
10.	Double Immunodiffusion (Ouchterlony)	3	CO5
11.	COVID Test kit method	3	CO5
Reference Books:			
1.	<i>Rajan, Sand Selva Christy, R.2010. Experimental Procedures in Life Sciences. [First Edition]. Anjanaa Book House, Chennai.</i>		
2.	<i>Kannan, N. Laboratory Manual in General Microbiology. [Second Edition]. Panima publishing corporation, New Delhi.</i>		
3.	<i>Aneja, K. R. 2003. Experiments in Microbiology, Plant pathology and Biotechnology. [Fourth Edition]. New age International.</i>		

COURSE OUTCOMES (CO)

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

CO1	Identify viral infections by serological method diagnosis.
CO2	Analyze the blood group of individuals and also analyze the enteric fever and their causative agent.
CO3	Utilize immunotechniques for qualitative analysis of antigens.
CO4	Evaluate Streptococcal infections by serological methods and determine the infection status based on CRP level.
CO5	Identify the presence of rheumatoid factor among suspected patients and diagnose HIV, hepatitis viral infection among risky populations.

23UCSMBAP401	GEC PRACTICAL III: PYTHON AND OFFICE AUTOMATION LAB (For the students of B.Sc.,Microbiology)	SEMESTER - IV	
COURSE OBJECTIVES: The Course aims <ul style="list-style-type: none"> • To make students understand the concepts of Python programming • To acquire basic concepts of MS Word, MS Excel, MS PowerPoint and its applications. 			
Credit Points: 2		Total Hours: 20	
S.NO	PROGRAMS	Hrs	CO
1.	Program using variables, constants, I/O statements in Python.	2	CO1
2.	Program using Operators in Python.	2	CO1
3.	Program using Conditional Statements.	2	CO2
4.	Program using Loops.	2	CO2
5.	Program using Jump Statements.	2	CO2
MS - Word			
6.	Designing a Personal Profile using following options <ul style="list-style-type: none"> • Font styles. • Page layout, Page Setup (Setting Margins, Changing Page Size, Changing Page Orientation and Applying Page Background). • Table. 	2	CO3
7.	Creating a Document for topic presentation with following options <ul style="list-style-type: none"> • Single and Double Column. • Page numbers. • Headers and Footers. • Date and time, Pictures and Shapes. 	2	CO3
MS - Excel			
8.	Entering Data for Stock Analysis using the following options <ul style="list-style-type: none"> • Formatting the Cells. • Sorting and Filtering. 	2	CO4

9.	Creating a Chart for Lab Stock Maintenance with sample data.	2	CO4
MS - PowerPoint			
10.	Creating a Presentation with Animation effects.	2	CO5
WEB REFERENCES:			
1.	https://www.tutorialspoint.com		
2.	https://www.free-computer-tutorials.net		
3	https://www.edu.getglobal.org		
4	https://www.w3schools.com		

COURSE OUTCOMES (CO):

After the completion of this course, the student will be able to

CO1	Understand the basics concepts of python.
CO2	Working with Looping and jump statements.
CO3	Create professional and academic documents by applying different formats and styles.
CO4	Create, edit and enhance basic Excel spreadsheet using formula and charts.
CO5	Understand basic power point using templates, animations and slide transitions.

23UMBSB401	SEC II: CLINICAL LABORATORY TECHNOLOGY	SEMESTER IV	
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> • To provide laboratory practices and safety measures. • To learn sample collection from patients and clinical laboratory techniques. • To gain knowledge about quality standards in health laboratories. 			
Credits: 02		Total Hours: 25	
UNIT	CONTENTS	Hrs	CO
I	Introduction to Clinical Laboratory Science: Basic laboratory principles - Organization of clinical laboratory and role of medical laboratory technician - Safety measures. Maintenance of Hygiene & Infection Control Practices.	05	CO1
II	Specimen Collection and Processing - Blood, urine, stool and sputum. Separation of serum and plasma. Handling of specimens for testing, preservation of specimens, transport of specimens and factors affecting the clinical results.	05	CO2
III	Introduction to Haematology: Anticoagulants, Blood collection system, Blood cell count - RBC, WBC, Estimation of hemoglobin. Erythrocyte sedimentation rate. Automation in haematology, bleeding time and clotting time.	05	CO3
IV	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.	05	CO4
V	Quality Standards in Health Laboratories - Development and implementation of standards, Accreditation Boards -NABL, ISO,	05	CO5

	CAP, COLA, Performing quality assessment - pre-analytical, analytical, and post-analytical phases of testing.		
Text Book:			
1.	Mukharji,K.L. (2022).Medical Laboratory Techniques, Vol - I, II & III, 5 th Edition. Tata McGrawHill, Delhi.		
2.	Ochei,A., Kolhatkar.A. (2000).Medical Laboratory Science: Theory and Practice, McGraw Hill Education.		
3.	Ramnik Sood (2015).Concise Book of Medical Laboratory Technology: Methods and Interpretation, 2 nd Edition, Jaypee Brothers Medical Publishers, NewDelhi.		
4.	S. Ramakrishnan, K N Sulochana (2012). Manual of Medical Laboratory Techniques , Jaypee Brothers Medical Publishers Pvt. Ltd		
5.	Talib V.H. (2019). <i>Handbook Medical Laboratory Technology</i> , 2 nd Edition, Directorate of health services, Government of India.		
Reference 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, 7 th Edition, CBS Publishers and Distributors Pvt. Ltd.		
3.	Godkar (2021).Textbook of Medical Laboratory Technology, 3 rd Edition, Bhalani Publishing House.		
4.	M.N.Chatterjee and Rana Shinde.(2008). Textbook of Medical Biochemistry, 7 th Edition, Jaypee Brothers Medical Publishers Pvt. Limited.		
5.	James G Cappucino. and Natalie Sherman. (2016). Microbiology - A laboratory manual. (5 th 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>**COURSE OUTCOMES (CO)**

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

CO1	Practice safety or infection control procedures in the clinical laboratory.
CO2	Understand the principles and practices of clinical sample collection.
CO3	Perform basic hematological techniques.
CO4	Identify the basic structure of cells, tissues by histopathology techniques.
CO5	Interpret, implement, and complying with laws, regulations and accrediting standards.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	H	M	M
CO2	H	H	M	H	M	H	M	H	H	M
CO3	H	H	M	H	M	H	M	H	H	M
CO4	M	H	M	H	H	M	M	M	H	H
CO5	H	H	M	H	H	H	M	H	H	H

H - High; M- Medium; L - Low

23UVE401	AECC: YOGA	SEMESTER IV	
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> • To understand physical body and Health concepts. • To have the basic Knowledge on Simplified Physical Exercises and Asanas and Meditation. • To Introspect and improve the behaviors. • To inculcate cultural behavioral patterns. 			
Credits: 02		Total Hours: 30	
UNIT	CONTENTS	Hrs	CO
I	<p>Yoga and Physical Health: Health - Meaning and Definition - Physical Structure - Three bodies - Five limitations - Simplified Physical Exercises - Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana 1, 2 , Massage, Acu pressure, Relaxation exercises - Yogasanas - Surya namaskar - Padmasana - Vajrasana - Ardha katti Chakrasana - Viruchasana - Yogamudra - Patchimothasana - Ustrasana - Vakkarasana - Salabasana.</p>	6	CO1
II	<p>Greatness of Life Force and Mind: Maintaining youthfulness - Postponing the ageing process - Sex and spirituality - Significance of sexual vital fluid - Married life - Chastity - Development of mind in stages - Mental Frequencies - Methods for Concentration - Meditation and its Benefits.</p>	6	CO2
III	<p>Personality Development - Sublimation : Purpose and Philosophy of Life - Introspection - Analysis of Thought - Moralization of Desire - Analysis and practice - Neutralization of Anger - Strengthening of will-power.</p>	6	CO3
IV	<p>Human Resources Development: Eradication of Worries - Analysis and Eradication practice - Benefits of Blessings – Effect of good vibrations - Greatness of Friendship - Guidance for</p>	6	CO4

	good Friendship - Individual Peace and world peace - Good cultural behavioral patterns.		
V	Law of Nature: Unified force - Cause and effect system - Purity of thought deed and Genetic Centre - Love and Compassion - Gratitude - Cultural Education - Fivefold culture.	6	CO5
Text Book:			
1.	Value Education - World Community Service centre, Vethathiri Publications, Erode.		
Reference Books:			
1	<i>Vethathiri Maharishi</i> , 2011, Journey of Consciousness, Erode, Vethathiri Publications.		
2	<i>Vethathiri Maharishi</i> , 2014, Simplified Physical Exercises, Erode, Vethathiri Publications.		
3	<i>Vethathiri Maharishi</i> , 2004, Unified force, Erode, Vethathiri Publications.		
4	Yoga for Modern age - Thathuvagnani Vethathiri Maharishi.		
5	Sound Health through yoga - Dr. K. Chandrasekaran, November 1999 Prem Kalyan Publications, Madurai.		
6	Light on yoga - BKS.lyenger.		
7	Thathuvagnani Vethathiri Maharishi - Kayakalpa yoga - First Edition 2009 - Vethathiri Publications, Erode.		
8	Environmental Studies - Bharathidasan University Publication Division.		

COURSE OUTCOMES (CO)

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

CO1	Understand the physical structure and simplified physical exercises.
CO2	Nurture the life force and mind.
CO3	Introspect and improve the moral values.
CO4	Realize the importance of human resources development.
CO5	Enhance purity of thought and deed.

23ULS401	NCC: CAREER COMPETENCY SKILLS - II	SEMESTER - IV	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To impart knowledge on the aptitude skills. To enhance employability skills and to develop career competency. 			
Total Hours: 15			
UNIT	CONTENTS	Hrs	CO
I	Aptitude: Speed Maths - Multiplication of Numbers - Simplification - Squaring of numbers - Square roots and cube roots - HCF&LCM -Decimals-Averages, Powers and Roots.	3	CO1
II	Aptitude: Problems on Numbers – Problems on Ages – Surds & Indices – Percentage – Profit & Loss – Ratio & Proportion – Partnership – Chain Rule.	3	CO2
III	Aptitude: Simple & Compound Interest – Alligation or Mixture - Permutation and Combination.	3	CO3
IV	Aptitude: Probability – Missing Number series – Wrong Number Series –Races & Games of Skill.	3	CO4
V	Aptitude: Time & Work – Pipes & Cistern – Time & Distance – Problems on Trains – Boats and Streams.	3	CO5
Text Book:			
1.	<i>Quantitative Aptitude – RS Aggarwal, S Chand and Company Limited, 2017Edition, New Delhi</i>		
Reference Book:			
1.	<i>Quantitative Aptitude for Competitive Examinations, Abhijith Guha, 5th Edition, Tata McGraw Hill, 2015, New Delhi.</i>		

COURSE OUTCOMES (CO)

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

CO1	Solve problems involving the concepts HCF, LCM, Decimals, Averages, Powers and Roots.
CO2	Solve problems on numbers and ages, Profit and Loss, Ratio and Proportions
CO3	Compute simple interest, compound interest, Permutation and Combination.
CO4	Solve the problems involving the concepts Missing numbers, Wrong number series, Races and Games of Skill
CO5	Solve problems on Time and Work, Piper and Cistern, Time and Distance, Trains, Boats and Streams.

23UMBAL401	ACC I: BIOFERTILIZER TECHNOLOGY	SEMESTER IV
Course Objectives:		
The course aims		
<ul style="list-style-type: none"> To learn the scope and importance of biofertilizers. To study mass cultivation methods of various biofertilizers. 		
Credit: 2		
UNIT	CONTENTS	CO
I	Introduction to Biofertilizers: Structure and characteristic features of the following biofertilizer organisms - <i>Azospirillum</i> , <i>Azotobacter</i> , <i>Rhizobium</i> and <i>Frankia</i> .	CO1
II	Biofertilization Processes: Decomposition of organic matter and soil fertility and vermicomposting. Mechanism of phosphate solubilization and phosphate mobilization. Free living and symbiotic nitrogen fixation.	CO2
III	Cultivation Techniques: Isolation, purification, mass multiplication, formulation and crop response of inoculants - <i>Rhizobium</i> , <i>Azotobacter</i> and <i>Azospirillum</i> and phosphate solubilizer (<i>Pseudomonas striata</i>).	CO3
IV	Cyanobacteria: Isolation, purification, mass multiplication and application of cyanobacterial bioinoculants. <i>Azolla</i> - mass cultivation and its application.	CO4
V	Mycorrhizae: Ecto and endomycorrhizae. Isolation of AM fungi - Wet sieving method and sucrose gradient method. Mass production of AM inoculants and field applications.	CO5
Text Books:		
1.	<i>Somani, L.L., S.C. Bhandari, K.K. Vyas and S.N. Saxena. 1990. Biofertilizers. Scientific Publishers - Jodhpur.</i>	
2.	<i>Tilak, K.V.B. 1991. Bacterial Biofertilizers. ICAR Pub., New Delhi.</i>	

Reference Books:

1.	<i>Purohit, S.S., P.R. Kothari and S.K. Mathur. 1993. Basic and Agricultural Biotechnology. Agro Botanical Pub. India.</i>
2.	<i>Subba Rao, N. S. 1988. Biological Nitrogen Fixation: Recent Developments. Oxford and IBH Pub. Co. Pvt. Ltd., India.</i>
3.	<i>Subba Rao, N.S., G.S. Venkataraman and Kannaiyan. S. 1993. Biological Nitrogen Fixation. ICAR Pub., New Delhi.</i>

COURSE OUTCOMES (CO)

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

CO1	Discuss the economic importance of biofertilizers.
CO2	Understand the nitrogen fixation process.
CO3	Apply the various formulation and cultivation methods for biofertilizer production.
CO4	Demonstrate the cyanobacterial biofertilizer production.
CO5	Outline the field application of mycorrhizal bioinoculants.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	M	H	H	H	H	M	H
CO2	H	H	H	H	H	H	H	H	H	H
CO3	H	M	H	H	H	H	M	H	H	H
CO4	H	M	H	H	H	H	M	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H

H - High; M- Medium; L - Low

23UMBM501	DSC V: FUNDAMENTALS OF VIROLOGY	SEMESTER V	
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> • To gain knowledge about properties of viruses and life cycle in host cells. • To learn about advanced techniques in viral cultivation methods. • To understand role of pathogenesis and their diagnostic methods. • To ascertain the importance and application of antiviral drugs and their mode of actions. 			
Credits: 04		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	<p>Virus: History of virology, General properties of viruses</p> <p>- Structure of viruses- capsids, nucleocapsid, nucleicacids-Viral envelopes and enzymes. Baltimore Classification of viruses- DNA and RNA viruses.</p>	10	CO1
II	<p>Cultivation of Viruses: Embryonated eggs, Animals Cell cultures- Primary and Continuous cell cultures. Viral purification, Viral Assays- Haemagglutination assay- Plaque assay.</p>	10	CO2
III	<p>Plant Viruses: Structure, mode of transmission, Symptoms, Prevention and control of Tobacco Mosaic Virus, Cucumber Mosaic Virus, Potato Spindle Tuber Virus and Cauliflower Mosaic Virus.</p>	10	CO3
IV	<p>Animal Viruses: Structure, replication. Pathogenesis and Laboratory diagnosis of Poxvirus, Herpes simplex virus, Polio virus, Influenza virus, MMR, Rabies virus, HIV and Corona virus. Antiviral drugs and their mode of actions.</p>	10	CO4

V	Bacteriophages: Classification, structure and life cycle of Single stranded DNA phages- Φ x 174 and M13; double stranded DNA phages- T4 and lambda. Viroids.	10	CO5
Text Books:			
1.	<i>Edward K. Wagner, Martinez J. Hewlett.</i> 2003. Basic Virology. Black well Science, Inc.		

Reference Books:	
1.	<i>Dimmock, K.J. and Primrose, S. B.</i> 2006 Introduction to Modern Virology. [6 th Edition]. Black well Science Ltd., UK.
2.	<i>Lewy, J. A, Fraenled H. C and Owens. R. A.</i> 1994. Virology. [Third Edition]. Prentice Hall, New Jersey, USA.
3.	<i>Ananthanarayanan, R and Jayaram Panicker, C.K.</i> 2022. [12 th Edition]. Text Book Of Microbiology. Orient Longman.
4.	<i>Biswass, S. B.and Amita Biswass.</i> 2006. An Introduction to Viruses. [Fourth Edition]. Vikas Publishing House Pvt. Ltd., New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Recall the general properties of viruses.
CO2	Understand the mode of expansion of viruses.
CO3	Assess the importance of prevention and control of plant viruses.
CO4	Apply Antiviral drugs for controlling the viral infections.
CO5	Compute the life cycles of phages.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	H	M	M	M	M	M
CO2	H	H	H	H	H	H	H	H	M	H
CO3	H	H	H	H	H	H	H	H	M	H
CO4	M	M	M	M	H	M	M	M	M	M
CO5	H	H	H	H	H	H	H	H	M	H
H - High; M- Medium; L - Low										

23UMBM502	DSC VI: ENVIRONMENTAL MICROBIOLOGY	SEMESTER V	
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> • To impart the significant processes involving in environmental microbiology. • To understand bioremediation process and biofuel production. 			
Credits: 03		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	<p>Ecological Principles: ecosystem- types of ecosystems- dynamics of ecosystem- Food chain, Food web. Microbial diversity –conventional and molecular methods of studying microbial diversity.</p>	10	CO1
II	<p>Air and Aquatic Microbiology: Aerosol- droplet and droplet nuclei. Enumeration of bacteria from air – Air sampling devices, Air borne diseases and their control measures and Air sanitation. Potability of water quality- Indicator organisms-MPN index. Eutrophication. Water borne diseases and their control measures.</p>	10	CO2
III	<p>Sewage Microbiology: Chemical and Biochemical characteristics of sewage-Biological oxygen demand; Chemical oxygen demand. Sewage treatment-Physical, chemical and biological (trickling filter, activated sludge and oxidation pond)- Solid waste treatment- Saccarification and Pyrolysis.</p>	10	CO3

IV	Role Of Microbes In Environment: Bioremediation-types and its applications; bioremediation of hazardous waste and metals; biodegradation of paper, oil, pesticide and xenobiotic compound. Bio-deterioration of leather and textiles. Bioleaching of ores.	10	CO4
V	Microbial Conversion Of Solid Waste To Food: Mushroom, SCP. Biofuel production- bioethanol, biogas, hydrogen and algal fuel. Applications of GIS and RS in environmental monitoring. Microbial composting and Vermicomposting.	10	CO5
Text Books:			
1.	<i>Ronald, M Atlas and Richard Bartha.</i> 2005 . Microbial Ecology. 4 th Edition, Benjamin / Cummings Science Publishing.		
2.	<i>Vijaya Ramesh, K.</i> 2004. Environmental Microbiology. 1 st Edition, MJP Publishers (Aunit of Tamil Nadu Book house), Chennai.		

Reference Books:	
1.	<i>Mithell R.</i> 2010. Introduction to Environmental Microbiology. Prantice Hall. Inc., Englewood Cliffs, New Jersey.
2.	<i>Daniel J. C.</i> 1999. Environment Aspects of Microbiology. 1 st Edition, Bright sun Publications, Chennai.
3.	<i>Raina, M. M, Ian, L. P and Charles, PG.</i> 2000. Environmental Microbiology. Academic Press, USA.

COURSE OUTCOMES (CO)

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

CO1	Recall the existence of living organisms and communities.
CO2	Evaluate air quality, air sanitation and control air borne diseases.
CO3	Create awareness about proper disposal and recycling of waste water.
CO4	Develop remediation for control environmental pollution using microorganisms.
CO5	Assess commercial application of microbial products.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	M	M	M
CO2	H	H	H	H	H	H	H	H	M	H
CO3	H	H	H	H	H	H	H	H	M	H
CO4	M	M	M	M	M	H	H	H	M	H
CO5	H	H	H	H	H	H	H	H	M	H

H - High; M- Medium; L - Low

23UMBM503	DSC VII : SOIL AND AGRICULTURAL MICROBIOLOGY	SEMESTER V	
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> • To gain knowledge about basics of soil profile. • To understand role of soil microorganisms and its interactions. • To ascertain the importance and application of bio-fertilizers and bio control agents. 			
Credits: 03		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	<p>Soil Profile: Introduction, Classification, types, Properties, structure, texture and formation of soil. Microbial grouping- Autochthonous, Allochthonous and Zymogenous microbes. Significance of soil microbes- Bacteria, Archaea, Eukaryotic algae, Cyanobacteria, Fungi and Actinobacteria.</p>	10	CO1
II	<p>Biogeochemical Cycle and Nitrogen Fixers: Carbon cycle, Phosphorous cycle, Sulphur cycle and Nitrogen cycle. Biochemistry of nitrogen fixation- Nitrogenase, hydrogenase, <i>nif</i> gene and <i>nod</i> gene. Nitrogen fixation- Symbiotic and Non symbiotic Nitrogen fixers.</p>	10	CO2
III	<p>Interactions Among Soil Microbes And Plants: Neutralism, Commensalism, Symbiosis, Synergism, Amensalism, Parasitism, Predation and Competition. Rhizosphere concept, R:S ratio, Rhizoplane; Spermosphere; Phyllosphere, Mycorrhizae.</p>	10	CO3

IV	Phyto Pathology: Introduction, Symptoms, disease cycle and control measures. Bacterial diseases- Blight of rice, Citrus canker. Mycoplasma disease- little leaf of brinjal. Fungal disease- Light blight of potato, Red rot of sugarcane, Wilt of cotton and Tikka leaf spot of groundnut.	10	CO4
V	Biofertilizers, Biopesticides and Biocontrol Agents: Mass multiplication, field application and crop response to <i>Rhizobium</i> , and <i>Azospirillum</i> and Phosphobacterium. Mode of action, formulation and application methods of biopesticides <i>Bacillus thuringensis</i> and <i>Brevvaria bassiana</i> .	10	CO5

Text Books:

1.	<i>Ronald, M Atlas and Richard Bartha.</i> 2005 . Microbial Ecology. 4 th Edition, Benjamin / Cummings Science Publishing.
2.	<i>Rangaswam, G. and A. Mahadvan.</i> 1999. Diseases of crop plants in India. Fourth edition. Prentice Hall of India Pvt Ltd., New Delhi.
3.	<i>Alexender, N. Glazer and Hiroshi Nikaido, W.H.</i> 2007. Microbial Biotechnology. Freeman and Company.

Reference Books:

1.	<i>Subbarao, N. S.</i> 2020. Biofertilizers in Agriculture and forestry, 3 rd Edition, Oxford and IBH Pub. Co. Pvt. Ltd, New Delhi.
2.	<i>Bawden. F. C.</i> 2002. Plant Diseases. Green world. First Edition in India. Efficient off set printers. New Delhi.
3.	<i>Mark S.Coney.,</i> 1999. Soil Microbiology: An exploratory approach. Delmar publishers, Singapore.

COURSE OUTCOMES (CO)

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

CO1	Analyze the soil profile and its properties.
CO2	Understand biogeochemical cycles and biological nitrogen fixation mechanism.
CO3	Compute interactions with soil microbes and plants.
CO4	Assess the disease established by phyto pathogens.
CO5	Prepare effective biofertilizers for improving soil health.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	M	M	M
CO2	H	H	H	H	H	H	H	H	M	H
CO3	H	H	H	H	H	H	H	H	M	H
CO4	M	M	M	M	M	H	H	H	M	H
CO5	H	H	H	H	H	H	H	H	M	H

H - High; M- Medium; L - Low

23UMBM504	DSC VIII : MEDICAL BACTERIOLOGY	SEMESTER V	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> • To gain knowledge about the pathogenesis. • To understand the importance of collection, transport, storage and processing of clinical samples. • To ascertain the antigenic properties of pathogens. • To enhance employability skills in clinical laboratory. 			
Credits: 04		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Bacterial Disease: Infection- Host interactions- adhesion, invasion, host damage, spread, multiplication and release of pathogen. Normal flora of human-skin, eye, respiratory tract and gastrointestinal tract.	10	CO1
II	Clinical Samples Collection: Collection, Transport, Storage And Processing Of Blood, Urine, Sputum and Body fluids. Hospital Acquired infection and their control.	10	CO2
III	Gram Positive Bacteria: Morphology, cultural characteristic, pathogenesis, lab diagnosis and control of Gram Positive organisms - <i>Staphylococcus aureus</i> , <i>Streptococcus pyogenes</i> , <i>Bacillus anthracis</i> , <i>Mycobacterium tuberculosis</i> , <i>Corynebacterium diphtheriae</i> , <i>Clostridium botulinum</i> and <i>Clostridium tetani</i> .	10	CO3
IV	Gram Negative Bacteria: Morphology, cultural characteristic, pathogenesis, lab diagnosis and control of gram negative organisms - <i>Escherichia coli</i> , <i>Klebsiella pneumoniae</i> , <i>Proteus vulgaris</i> , <i>Salmonella typhi</i> , <i>Salmonella paratyphi</i> , <i>Shigella flexneri</i> , <i>Pseudomonas aeruginosa</i> and <i>Vibrio cholerae</i> .	10	CO4

V	Sexually Transmitted Organisms: Morphology, cultural characteristic, pathogenesis, lab diagnosis and control of <i>Treponema pallidum</i> , <i>Neisseria gonorrhoeae</i> , <i>Chlamydia trachomatis</i> , <i>Mycoplasma genitalium</i> , <i>Haemophilus ducreyi</i> .	10	CO5
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Text Books:

1.	<i>Chakraborty, P.</i> 2003. A Text book of Microbiology . Second edition, Published by New Central Agency (P) Ltd., Kolkata.
2.	<i>Ananthanarayanan, R and Jayaram Panicker, C.K.</i> 2022. [12 th Edition]. Text Book Of Microbiology . Orient Longman.
3.	<i>Satish ,G.</i> 2020. The Short Text book of Medical Microbiology . 11 th edition, Jaypee Brothers, Medical publishers (P) Ltd., New Delhi.

Reference Books:

1.	<i>Baron, E. J ,Peterson, L. R., and Fine gold, S. M.</i> 1994. Bailey and Scotts Diagnostic microbiology . 9 th edition, Mosby publications.
2.	<i>Rajan, S.</i> 2021. Medical Microbiology . First edition, MJP Publishers, Chennai.6.
3.	<i>Rajesh Bhatia and Ratan Lallchhpujani.</i> 2004. Essentials of Medical Microbiology . Third edition, Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.
4.	<i>Sundararaj, T.</i> 2005. Microbiology Laboratory Manual , Perungudi, Chennai - 96.
5.	<i>Jawetz, Melnick, and Adelberg' s.</i> 2013. Medical Microbiology . 26 th Edition. McGraw- Hill.

COURSE OUTCOMES (CO)

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

CO1	Analyze microbial diseases and normal flora.
CO2	Understand the proper processing of clinical samples.
CO3	Analyze and diagnose the infections caused by Gram positive pathogens.
CO4	Analyze and diagnose the infections caused by Gram negative pathogens.
CO5	Create awareness for sexually transmitted diseases

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	M	M	M
CO2	H	H	H	H	H	H	H	H	M	H
CO3	H	H	H	H	H	H	H	H	H	H
CO4	M	M	M	M	M	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	M	H

H - High; M- Medium; L - Low

23UMBEL501	DSE I: MEDICAL MYCOLOGY AND PARASITOLOGY	SEMESTER V	
Course Objectives: The course aims <ul style="list-style-type: none"> • To acquire knowledge of fungal and parasitic diseases, etiology, diagnosis and treatment. • To understand the taxonomy, morphology, and pathogenesis of human parasites and fungi. 			
Credits: 03		Total Hours: 40	
UNIT	CONTENTS	Hrs	CO
I	Mycology: Historical introduction to Mycology- Morphology - Taxonomy - Nomenclature and Classification of fungi - Isolation and identification of fungi from clinical samples. Mycotoxins. Antifungal agents-Testing methods and quality control. Virulence factors of fungi.	08	CO1
II	Fungal Diseases: Superficial mycosis- <i>Tinea, Piedra</i> - Dimorphic fungi causing Cutaneous mycosis- Dermatophytosis. Subcutaneous mycosis- Sporotrichosis and Mycetoma. Systemic mycosis- Histoplasmosis. Opportunistic mycosis- Candidiasis, and Aspergillosis.	08	CO2
III	Medical Parasitology: Morphology, classification, characteristics, pathogenesis, laboratory diagnosis, prevention and control. Intestinal amoebae - <i>Entamoeba histolytica, Giardia lamblia</i> . Free living Amoebae- <i>Naegleria fowleri</i> . Blood and tissue flagellates - <i>Trichomonas vaginalis, Trypanosoma brucei, Trypanosoma cruzi</i> . Malarial parasite- <i>Plasmodium falciparum, Plasmodium vivax</i> .	08	CO3

IV	Helminths Infection: <i>Taenia solium</i> , <i>T. saginata</i> , <i>Fasciola hepatica</i> , and <i>Schistosomes</i> , <i>Ascaris lumbricoides</i> , <i>Ancylostoma duodenale</i> and <i>Wuchereria bancrofti</i> .	08	CO4
V	Laboratory Techniques in Parasitology: Examination of faeces- Direct and concentration methods. Blood smear examination - Cultivation of protozoan parasites, Serology and PCR techniques.	08	CO5
Text Books:			
1. 2. 3. 4.	<p><i>Jagdish chander</i>. 2018. Text book of Medical Mycology. 4th edition, Taypee Publisher.</p> <p><i>Gopinath hait</i>. 2017. A Textbook of Mycology. New central book agency (NCBA).</p> <p><i>Jayaram Paniker, C. K.</i> 2022. Paniker’s Text book of Medical Parasitology. 12th edition, Jaypee Brothers Medical Publishers (P) Ltd, 2013.</p> <p><i>Parija, S. C.</i> 2013. Text Book of Medical Parasitology- Protozoology and Helminthology. 4th Edn. All India Publishers and Distributors, New Delhi.</p>		
Reference Books:			
1. 2. 3.	<p><i>Errol reiss, H. Jeans shadomy, G. Marshal lyon</i>. 2014. Fundamental Medical Mycology. Weiley Black well.</p> <p><i>Russel, F. Cheadle and Ruth Leventhal</i>. 2011. Medical Parasitology.</p> <p><i>Chatterjee, K. D.</i> 2023. Parasitology: Protozoology and Helminthology. 13th Edn. CBS Publishers & Distributors Pvt. Limited.</p>		

COURSE OUTCOMES (CO)

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

CO1	Analyze proper processing of fungal infected clinical samples.
CO2	Understand the superficial, cutaneous, subcutaneous and opportunistic fungal pathogens.
CO3	Analyze and diagnose the infections caused by parasites.
CO4	Analyze and diagnose Helminths Infection.
CO5	Develop laboratory techniques in Parasitology.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	H	H	H	H	H	H	H	H	H	H
CO2	M	M	M	M	M	M	M	M	M	M
CO3	H	H	H	H	H	H	H	H	H	H
CO4	M	M	M	M	M	M	M	M	M	M
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMB MEL502	DSE I: CELL BIOLOGY	SEMESTER V	
Course Objectives: The course aims			
<ul style="list-style-type: none"> • To ascertain the cellular level organization and its functions • To understand about the activation, regulation of cellular metabolism. • To learn signal transduction processes. 			
Credits: 03		Total Hours: 40	
UNIT	CONTENTS	Hrs	CO
I	Structure and organization of cytoskeleton: microfilaments, microtubules and intermediate filament. Structure and functions of nucleus, mitochondria, chloroplasts, endoplasmic reticulum and golgi apparatus- protein trafficking.	08	CO1
II	Cell cycle : Events and regulation in cell cycle. Microtubules and mitosis. Cell movements. Intracellular transport and the role of kinesin and dynein.	08	CO2
III	Cell interaction: Ca ⁺⁺ dependent and independent cell-cell adhesion. Cell junctions and adhesion molecules, mitosis, meiosis, role of cyclins and cyclin dependent kinases, regulation of Cdk - cyclin activity.	08	CO3
IV	Signal transduction: G Protein couple receptors (GPCR), second messenger, role of cAMP and cGMP, steroid/peptide hormone regulation, tissue specific regulation - protein folding- molecular chaperones.	08	CO4
V	Cell division regulation and cancer: Role of protein kinases, Programmed cell death (PCD) - Autophagy and apoptosis. Geno toxicity assays.	08	CO5

Text Books:

1. Ajoy Paul. 2011. **Text Book of Cell and Molecular Biology**, Books and Allied Ltd.,

New Delhi.

Reference Books:	
1.	Lodish, H., Berk A., Kaiser C. A., Krieger M., Scott M.P., Bretscher A., Ploegh H., and Matsudaira P. 2008. Molecular Cell Biology , [Sixth Edition]. Freeman, W. H. and Co.
2.	Geoffrey, M. Cooper and Hausman, R.E. 2007. The cell – A Molecular Approach . [Fourth Edition]. ASM Press, Washington, D.C.
3.	Sadava, D.E. 2004. Cell Biology: Organelle Structure and Function . Reprint, [First Edition]. Panima Publishing Corp., India.

COURSE OUTCOMES (CO)

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

CO1	Recall about structural components and internal organelles.
CO2	Assess cell cycle and its regulations.
CO3	Analyze cell cycle mechanisms.
CO4	Apply cell signal transduction for design drugs.
CO5	Develop drugs for cancer therapy.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	M	M	M
CO2	H	H	H	H	H	H	H	H	H	H
CO3	M	M	M	M	M	M	M	M	M	M
CO4	M	M	M	M	M	M	M	M	M	M
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBMP501	DSC PRACTICAL V	SEMESTER V	
Course Objectives:			
<ul style="list-style-type: none"> To estimate the environmental pollutants. To study plant growth promoting microorganisms. To acquire knowledge on identification of clinical pathogens. 			
Credits: 03		Total Hours: 60	
Experiment	CONTENTS	Hrs	CO
1.	Isolation of phages from sewage water sample.	05	CO1
2.	Estimation of BOD.	05	CO1
3.	Estimation of COD.	05	CO1
4.	MPN Technique.	05	CO1
5.	Enumeration of bacteria from air by open plate method and air sampler method.	05	CO1
6.	Isolation of phosphate solubilizing bacteria.	05	CO2
7.	Isolation of <i>Rhizobium</i> from root nodules.	05	CO2
8.	Isolation of <i>Azospirillum</i> from damp soil.	05	CO2
9	Microscopic examination of VAM fungi.	05	CO2
10.	Isolation and Identification of clinical pathogens from sputum samples.	05	CO3
11.	Isolation and Identification of clinical pathogens from pus samples.	05	CO3
12.	Isolation and Identification of clinical pathogens from urine samples.	05	CO3
Reference Books			
1.	<i>James G. Cappucino and Sherman Natalie. 2005. Microbiology - A Laboratory Manual. [Seventh Edition]. Pearson education India, New Delhi.</i>		

EXPERIMENT OUTCOMES (EO)	
CO1	Evaluate the purity of the water and air and analyze the pollutants present in the environment.
CO2	Develop sustainable agriculture through study of agriculturally important microorganisms.
CO3	Apply the diagnosis knowledge to detect the unknown pathogens from clinical samples.

23ULS501	NCC: CAREER COMPETENCY SKILLS - III	SEMESTER - V	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To impart knowledge on the logical reasoning. To enhance employability skills and to develop career competency. 			
Total Hours: 15			
UNIT	CONTENTS	Hrs	CO
I	Verbal Reasoning: Number Series Completion- Alpha Series Completion- Blood Relation- Distance and Direction- Analogy- Inequality- Classification.	3	CO1
II	Non-Verbal Reasoning: Series Completion - Analogy and Classification - Completion of Incompletion Pattern.	3	CO2
III	Non-Verbal Reasoning: Mirror Image and Water Image - Statement and Arguments - Cubes and Dices.	3	CO3
IV	Reasoning : Puzzle Arrangement - Syllogism - Input and Output.	3	CO4
V	Verbal Reasoning : Linear Arrangement - Circular Arrangement - Matrix Arrangement.	3	CO5
TextBook:			
1.	<i>Test of Reasoning – RS Aggarwal, S Chand and Company Limited, 2017 Edition, New Delhi.</i>		
ReferenceBook:			
1.	<i>Verbal & Non-Verbal Reasoning For Competitive Exams -Gajendra Kumar, Abhishek Banerjee, Disha publication, New Delhi.</i>		

COURSE OUTCOMES(CO)

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

CO1	Apply the core concepts of Verbal Reasoning
CO2	Formulate Non Verbal Reasoning with shortcuts
CO3	Solve problems involving Mirror image and Water image, Cubes and Dices.
CO4	Design and formulate Puzzle arrangement
CO5	Generate Linear Arrangement, circular arrangement and Matrix arrangements.

23UMBAL501	ACC I: MARINE MICROBIOLOGY	SEMESTER V
<p>Course Objectives:</p> <p>The course aims</p> <ul style="list-style-type: none"> This subject aims to introduce the students to understand microbial diversity, significance, and dynamics of marine environment, Marine microflora, and marine products. 		
Credit: 2		
UNIT	CONTENTS	CO
I	<p>Marine Environment: Properties of sea water, chemical and physical factors of marine environment-Ecology of coastal, shallow and deep sea microorganism - significance of marine microflora. Diversity of microorganism -Bacteria, Actinobacteria, Archaea, Cyanobacteria, Algae, Fungi, Viruses and Protozoa in the mangroves and coral environments.</p>	CO1
II	<p>Cultivation of Marine Microbes: Methods of studying marine microorganisms - sample collection-isolation and identification: Cultural, Morphological, Physiological, Biochemical and Molecular characteristics- Preservation methods of marine microbes.</p>	CO2
III	<p>Marine Extremophiles: Survival at extreme environments - starvation-adaptive mechanisms in thermophilic, alkalophilic, osmophilic and barophilic, psychrophilic microorganisms-hyper thermophiles, halophiles and their importance.</p>	CO3
IV	<p>Microbial Biodegradation: Natural and synthetic material in the marine environment pesticide, cellulose degradation, hydrocarbon production. Bioremediation of pollutants in marine environment.</p>	CO4

V	Marine Microbial Products: Carrageenan, agar-agar, seaweed fertilizers, Astaxanthin, β carotene- enzyme- antibiotics-antitumor agents- biosurfactants- pigments. Preservation of seafoods.	CO5
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Text Book	
1.	<i>Belkin, S and Colwell, R, R.</i> 2005. Ocean and health: Pathogens in the Marine Environment. Springer.
2.	<i>Munn and Munn.</i> 2011. Marine Microbiology: Ecology and Applications. BIOS Scientific publisher.
3.	<i>Atlas, R. M.</i> 1988. Microbiology, Fundamentals and applications. Maxwell McMillan International Editions.

Reference Books:	
1.	<i>Hunter - Cevera, J., Karl, D and Buckley, M.</i> 2005. Marine Microbial Diversity: the Key to Earth's habitability. American Academy of Microbiology.
2.	<i>Krichman D. L.</i> 2018. Microbial ecology of the oceans. Wiley liss, NewYork.
3.	<i>Rheinheimer, G.</i> 1980. Aquatic Microbiology - an Ecological Approach. Blackwell Scientific Publications.

COURSE OUTCOMES (CO)

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

CO1	Discuss Marine Environment and its diversity.
CO2	Be aware about isolation, preservation and bio geochemical cycle of marine microbes.
CO3	Demonstrate marine extremophiles and their importance.
CO4	Apply the marine microbes for biodegradations of various pollutant.
CO5	Create and develop the employable and entrepreneur opportunity in marine microbiology.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	M	M	M
CO2	H	H	H	H	H	H	H	H	H	H
CO3	M	M	M	M	M	M	M	M	M	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBM601	DSC IX : FERMENTATION TECHNOLOGY	SEMESTER VI	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To learn about the isolation, industrial medium formulation, sterilization and industrially important organism. To know the various component parts of the fermentor and its function. To get an idea about the sterility testing of pharma products. 			
Credits: 04		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Screening Techniques: Primary and secondary screening techniques. Preservation of culture. Strain improvement by rDNA techniques and mutation. Development of inoculums for various fermentation processes–Bacteria, fungi and yeast.	10	CO1
II	Fermentor: Introduction, Components and types of fermentor. Control systems in fermentation- pH, Temperature, Oxygen and foam. Computer applications in fermentation technology.	10	CO2
III	Upstream and Downstream Processing: Medium formulation– Water, carbon, nitrogen, minerals and antifoams. Medium sterilization-Batch & continuous sterilization. Recovery and purification of intracellular and extracellular products.	10	CO3
IV	Microbial Products from Industry: Microbial production of α -amylase and Vitamin B ₁₂ . Preparation of substrate, fermentation and recovery of Wine and Beer. Production of organic acids – Citric acid and Acetic acid. Microbial	10	CO4

	production of antibiotics – Inoculum preparation, fermentation and recovery of Penicillin and Streptomycin.		
V	Recombinant Products : Production and applications of Insulin , Interferon, Hepatitis B vaccine and Growth hormones.	10	CO5
Text Books:			
1.	<i>Stanbury, P. F., Whittaker ,A. and Hall, S. J.</i> 2016. Principles of Fermentation Technology . [Second Edition]. Aditya Books Pvt. Ltd., New Delhi.		
2.	<i>Patel, A. H., 2022.</i> An Introduction to Industrial Microbiology . Macmillan India Ltd., Chennai.		

Reference Books:			
1.	<i>Hugo, W .B. and Russell, A. D.</i> 2013. Pharmaceutical Microbiology . [Eighth Edition]. Black well scientific company Ltd., USA.		
2.	<i>Agarwal, A. K., and Pradeep, P.</i> 2012. Industrial Microbiology :Fundamentals and Applications. [First Edition]. Published by Agro bios (India).		

COURSE OUTCOMES (CO)

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

CO1	Analyze the strain improvement techniques for potent strain preparation.
CO2	Prepare basic techniques for fermentor design.
CO3	Demonstrate the upstream and downstream techniques.
CO4	Assess the techniques used in Industrial production of Alcoholic beverages and antibiotics.
CO5	Create improved technology for recombinant products.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	M	M	M	M	M	M	M	M	M	M
CO2	M	M	M	M	M	M	M	M	M	M
CO3	H	H	H	H	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBM602	DSC X: GENETIC ENGINEERING	SEMESTER VI	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> • To gain knowledge about basics of gene cloning. • To understand role of modifying enzymes in gene manipulation. • To ascertain the importance and application of genomic and cDNA libraries. • To learn about advanced techniques in creating transgenic animals and plants. 			
Credits: 04		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Tools of Genetic Engineering: Introduction, scope and applications of genetic engineering. Restriction enzymes: types, nomenclature, classification and uses. DNA modifying enzymes: Nuclease, polymerases, methylases and DNA ligases. DNA manipulative enzymes.	10	CO1
II	Cloning Vectors: Plasmid vectors- pBR322, pBR 327, pUC8, pGEM32. Bacteriophages, λ , M13 vectors, Hybrid vectors-Cosmids and Phagemids. Yeast vectors: YEp, YIp, Yrp and YAC. Bacterial Artificial Chromosome.	10	CO2
III	Gene Cloning: Basic steps in gene cloning- construction of cDNA and genomic DNA libraries. DNA delivery systems- Electroporation, Biolistics, Microinjection and Lipofection. Screening of recombinants.	10	CO3

IV	Techniques in Genetic Engineering: Radio labeling and non - radiolabelling of nucleic acids- End labeling-Nick translation. Blotting techniques: Southern, Northern and Western blotting. DNA sequencing: Chemical and enzymatic methods. Polymerase Chain Reaction and its applications.	10	CO4
V	Genetic Manipulation: Plant transformation with Ti plasmid of <i>Agrobacterium tumefaciens</i> - Ti plasmid- derived vector systems (Binary vector, Co -integrated vector). Development and use of Transgenic animals- Transgenic Mice Transgenic cattle and their applications.	10	CO5
Text Books:			
1.	<i>Brown, T. A.</i> 2020. Gene Cloning- An Introduction. [Eighth Edition]. Chapman and Hall, UK.		

Reference Books:	
1.	<i>Old, R. W. and Primrose, S. B.</i> 2014. Principles of Gene Manipulation- An Introduction to Genetic Engineering. 7 th Edition]. Black well Scientific Publications, London.
2.	<i>Winnacker, E. C.</i> 1987. From Genes to Clones - Introduction to Gene Technology. VCH, Weinheim.
3.	<i>Bernard R. Glick and Jack J. Pasternak.</i> Molecular Biotechnology - Principles and Applications of Recombinant DNA. Panima Publishing Corporation. NewDelhi.

COURSE OUTCOMES (CO)

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

CO1	Analyze the preparation of gene of interest for cloning.
CO2	Prepare effective technique for achieving transformants.
CO3	Demonstrate the techniques for screening the recombinants.
CO4	Assess the techniques used in creating the stable transformants.
CO5	Create novel transgenic plants and animals.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	H	H	H	H	H	H	H	H	H	H
CO2	M	M	M	M	M	M	M	M	M	M
CO3	H	H	H	H	H	H	H	H	H	H
CO4	M	M	M	M	M	M	M	M	M	M
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBM603	DSC XI: FOOD AND DAIRY MICROBIOLOGY	SEMESTER VI	
<p>Course Objectives: The course aims</p> <ul style="list-style-type: none"> • To understand the basic concepts of contamination, spoilage and preservation of food. • To acquire an overview about food borne infections and intoxications. • To learn about the quality control and standards of food. 			
Credits: 04		Total Hours: 50	
UNIT	CONTENTS	Hrs	CO
I	Food and Microorganisms: Important microorganisms in food (Bacteria, Mold and Yeasts). Factors affecting the growth of microorganisms in food- pH, moisture, oxidation -Reduction potential, nutrient content and inhibitory substances and biological structure.	10	CO1
II	Spoilage of Foods: Cereals and cereal products-Sugar and sugar products - Vegetables and fruits - Meat and meat products - Spoilage of canned food.	10	CO2
III	Food Borne Diseases: Food poisoning and food borne Infections- Bacterial and Mycotoxins. Investigation of food poisoning outbreaks.	10	CO3
IV	Principles of Food Preservation: General principles and application. Asepsis- techniques of removal of microorganisms- Use of temperature (Pasteurization-low and high). Drying, Radiation Chemical preservatives. Food additives.	10	CO4

V	Quality Control of Milk: MBRT, Litmus milk and Phosphatase tests. Quality assurance: Microbiological quality standards of food. Government regulatory practices and policies – HACCP and ISO.	10	CO5
Text Book:			
1.	<i>Frazier, W. C and Westhoff, D.C.</i> 2017 Food Microbiology . [Fifth Edition]. Tata Mc Graw-Hill Publishing Company Limited, New Delhi.		
Reference Books:			
1.	<i>Banwart, G. J.</i> 2017. Basic Food Microbiology . Chapman and Hall New York.		
2.	<i>Jay, J. M.</i> 2006 . Modern Food Microbiology . CBS Publishers and distributors, New Delhi.		
3.	<i>Adams, M. R. and Moss, M .O.</i> 2015. Food Microbiology . The Royal Society of Chemistry, Cambridge.		

COURSE OUTCOMES (CO)

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

CO1	Discuss importance of microbes in food and dairy microbiology.
CO2	Understand the spoilage of food products for product development.
CO3	Analyze food borne infections and intoxications for product preservation.
CO4	Evaluate different kinds of food preservation methods for product safety.
CO5	Demonstrate various fermented food products.

MAPPING										
PO & PSO \ CO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	M	M	M	M	M	M	M
CO2	H	H	H	H	H	H	H	H	H	H
CO3	M	M	M	M	M	M	M	M	M	M
CO4	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBEL601	DSE II : PHARMACEUTICAL MICROBIOLOGY	SEMESTER VI	
Course Objectives: <ul style="list-style-type: none"> • To learn about the synthetic antimicrobial agents and its mechanism of action. • To understand microbial contamination and spoilage of various pharmaceutical products. • To study the quality assurance and validation of pharmaceutical Industry. 			
Credits: 04		Total Hours: 40	
UNIT	CONTENTS	Hrs	CO
I	Antibiotics: Definition, scope and recent developments of pharmaceutical microbiology. Introduction, Classification of antibiotics and source of drugs. Routes of drug administration and pharmacological studies of microbes.	08	CO1
II	Microbial Contamination and Spoilage of Pharmaceutical Products: Microbial sources, contamination and spoilage of pharmaceuticals; Factors affecting microbial spoilage of pharmaceutical products.	08	CO2
III	Preclinical Development: Safety profile of drugs (Pyrogenicity, Toxicity, hepato, nephro, cardio and neurotoxicity), Toxicological evaluation of drug (LD 50, Acute, sub acute and chronic toxicity), Mutagenicity (Ames test, micronucleus test). and Carcinogenicity:	08	CO3
IV	Clinical Studies and Pharmaceutical Drug Analysis: Phase I, Phase II, Phase III and Phase IV of clinical trials–Objectives, Conduct of trials, Outcome of trials. Biosensors and applications in Pharmaceuticals; Macromolecular, cellular and synthetic drug carriers. Assay of steroids.	08	CO4

V	Quality Assurance and Validation: Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in Pharmaceutical Industry. Government regulatory practices and policies for pharmaceutical industry. FDA, CDSCO, DCGI. Formulation of drugs and patenting of pharmaceutical products.	08	CO5
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Text Books:

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| 1. | <i>Hugo and Russell.</i> 2013. Pharmaceutical Microbiology. [Eighth Edition]. Wiley-Blackwell Publishers, UK. |
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Reference Books:

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|----|---|
| 1. | <i>Purohit, S. S., Saluja, A. K. and Kakrani, H. N.</i> 2021. Pharmaceutical Microbiology. Agrobios, New Delhi. |
| 2. | <i>Lansing M Prescott, John P Harley and Donald A Klein.</i> 2022. Microbiology. [12 th Edition]. McGraw Hill, New York. |
| 3. | <i>Burn J.H.</i> Principles of Therapeutics, Black well Scientific Pub. O. Ltd. Oxford. |
| 4. | <i>Goldstein A., Aronow L., and Kalman S.M.</i> Principles of Drug Action, The Basis Of Pharmacology, Harper international edition New York. |
| 5. | <i>Mannfred A. Holliger.</i> 2008. Introduction to pharmacology, 3 rd Ed., CRC Press |

COURSE OUTCOMES (CO)

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

CO1	Recall the basics and working mechanism of antibiotics against infectious diseases.
CO2	Develop the pharmaceutical products without contamination and spoilage.
CO3	Optimize the production of pharmaceutical products.
CO4	Apply the technology in drug delivery systems.
CO5	Follow the protocols and regulations to validate pharmaceutical products.

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	H	H	H	H
CO4	M	M	M	M	M	M	M	M	M	M
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBEL602	DSE II: MICROBIOLOGY FOR SOCIAL WELFARE	SEMESTER VI	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To learn the importance and applications of microbial products. To study the patenting methods for novel products. To understand the entrepreneur opportunities in relevance to Microbiology. 			
Credits: 04		Total Hours: 40	
UNIT	CONTENTS	Hrs	CO
I	Microbial Technology: Bioactive compounds from microorganisms- Antibiotics-Production of Streptomycin. Novel Microbial products-Production of human insulin. Biopolymers- Engineering of <i>Xanthomonas campestris</i> . Biosequestration of heavy metal pollutants.	08	CO1
II	Institutions and Schemes of Government of India: Schemes and programmes, Department of science and technology schemes, Nationalized banks - other financial institutions etc- SIDBI- NSIC- NABARD- IDBI- IFCI- ICICI etc. Opportunities in & as NGO sectors.	08	CO2
III	Biofertilizers: Algal fertilizers- <i>Azolla</i> as fertilizer. Composting- domestic waste, agricultural and industrial waste, vermi composting and organic farming.	08	CO3
IV	Patenting in Microbial Biotechnology: Patents- patenting strategies. Copyrights. Trade secrets, Trademarks, WIPO, GATT & TRIPs. Patenting of Biological materials.	08	CO4
V	SCP production: Mushroom and Spirulina cultivation and its marketing. Probiotics and its use as animal feed.	08	CO5
Text Book:			
1	<i>Dubey, R.C (2009). A text book of Biotechnology, S.Chand & Company Ltd,</i>		

	New Delhi.
Reference Books:	
1.	<i>Subbarao, N. S.</i> 2020. Biofertilizers in Agriculture and forestry , 3 rd Edition, Oxford and IBH Pub. Co. Pvt. Ltd, New Delhi.
2.	<i>Bernard, R., Glick and Jack J Pasternik.</i> 2017. Molecular Biotechnology Principles and Application of Recombinant DNA . Panima Publishing Corporation, New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Discuss the valuable products of microbes
CO2	Understand the various government schemes and banking systems
CO3	Apply the microbes and its products as biofertilizers
CO4	Demonstrate the patenting methods for novel products
CO5	Outline the production of SCP and its marketing strategies

MAPPING										
PO & PSO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO										
CO1	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	H	H	H
CO3	M	M	M	M	M	M	M	M	M	M
CO4	M	M	M	M	M	M	M	M	M	M
CO5	H	H	H	H	H	H	H	H	H	H
H - High; M- Medium; L - Low										

23UMBMP601	DSC PRACTICAL VI	SEMESTER VI	
Course Objectives:			
<ul style="list-style-type: none"> To give keen knowledge about protein profiling. To develop skills to manipulate DNA for cloning. To study the quality of the milk by standard protocols. 			
Credits: 04		Total Hours: 50	
Experiment	CONTENTS	Hrs	CO
1.	Protein profiling by SDS-PAGE.	5	CO1
2.	Polymerase Chain Reaction.	5	CO1
3.	Restriction digestion and ligation.	5	CO2
4.	Methylene Blue Reduction Test (MBRT)	5	CO1
5.	Assessment of milk quality by Phosphatase test	5	CO3
6.	Examination of milk by Breeds count method	2	CO3
7.	Amylase production by Submerged fermentation	5	CO3
8.	Examination of fungi by slide culture technique.	5	CO1
9.	Giemsa stain	3	CO3
10.	Identification of blood parasite by Leishman Staining technique	5	CO3
11.	Identification of intestinal parasites by Iodine Mount method.	5	CO3
Reference Books			
1.	<i>Gakhar, S. K. and Monica Miglani</i> 2013. Molecular Biology: A Laboratory Manual . I. K. International house, Mumbai.		

COURSE OUTCOMES (CO)	
CO1	Apply the molecular techniques for protein analysis
CO2	Evaluate and analyze the purity of milk.
CO3	Demonstration of clinically important pathogens.

23ULS601	NCC: CAREER COMPETENCY SKILLS - IV	SEMESTER VI	
Course Objectives:			
The course aims			
<ul style="list-style-type: none"> To understand the basic needs of Communication To utilize the communication skills for achieving at the time of Interview 			
Total Hours: 15			
UNIT	CONTENTS	Hrs	CO
I	Spotting Errors – Parts of speech, Punctuation, Subject Verb agreement	3	CO1
II	E-Mail, Report Writing (3types), Interpretation of Charts.	3	CO2
III	Role Play – Just a Minute (JAM) –Story Narrating - Group Discussion	3	CO3
IV	Interview Presentation (Self-Introduction)-Dress Code & Body language.	3	CO4
V	Leadership, Critical thinking, Problem Solving.	3	CO5
Text Book:			
1.	<i>Mastering Interviews and Group Discussions</i>		
Reference Book:			
1.	<i>Mathur, Dinesh CBS Publishers & Distributors Pvt Limited, India, 30 Mar. 2020.</i>		

COURSE OUTCOMES (CO)

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

CO1	Recall the usage of grammar.
CO2	Interpret and exemplify the profession writing.
CO3	Apply the names of speaking in workspace.
CO4	Evaluate the personality during Interview.
CO5	Create the ability to enhance Personal Skills.

GUIDELINES

1. SUBMISSION OF RECORD NOTE BOOKS AND PROJECT DISSERTATION:

Candidates appearing for Practical Examinations and Project Viva-voce shall submit bonafide Record Note Books/Dissertation prescribed for Practical / Project Viva-voce Examinations, otherwise the candidates will not be permitted to appear for the Practical/ Project Viva-voce Examinations.

2. PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION

(Theory, Practical and Project)

A. THEORY

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 40 marks put together out of 100 in the Comprehensive Examination in each theory paper with a passing minimum of 30 marks in External out of 75.

Internal Marks Distribution [CA- Total Marks:25]

Attendance	: 5 Marks
Assignment	: 5 Marks
Internal Examinations	: 15 Marks
Total	: 25 Marks

B. (i) THEORY (If Internal Evaluation is for 100 Marks)

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 40 marks out of 100 in the Comprehensive Examination (Internal Evaluation only).

Internal Marks Distribution [CA- Total Marks: 100]

Attendance	: 10 Marks
Assignment	: 30 Marks (3 Assignments Compulsory)
Internal Examinations	: 60 Marks
Total	: 100 Marks

(ii) PRACTICAL

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 40 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 24 marks in External out of 60.

Internal Marks Distribution [CA- Total Marks: 40]

Experiment	: 10 Marks (10-12 Experiments)
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	: 40 Marks

III. PROJECT WORK

- The project work shall be carried out by students in groups during the VI semester and has to complete the work at the end of the semester.
- The students have to attend 2 reviews before completing his / her Project and it will be evaluated by an internal examiner.
- The assessment of students performance in a semester is calculated by Continuous Internal Assessment (CA) for 40 Marks and External Assessment for 60 Marks.
- Upon completion of the project work the candidate shall be required to appear for a Viva Voce conducted by an external examiner.
- The candidate shall be declared to have passed the Examination, the candidate secure not less than 40 Marks put together out of 100 in the Comprehensive Examination in Project with a passing minimum of 24 marks in external out of 60.

Mark Distribution Pattern

Internal Mark Distribution Continuous Assessment (CA) Total Marks: 40

1. Attendance	:	10 Marks
2. Review (2)	:	20 Marks
3. Presentation	:	10 Marks
Total	:	40 Marks

External Mark Distribution Comprehensive Examination (CE) Total Marks: 60

1. Project work done	:	20Marks
2. Project report	:	20Marks
3. Presentation	:	10Marks
4. Viva-Voce	:	10Marks
Total	:	60Marks

IV. NON CREDIT COURSE

Semester III and VI - Viva voce

- The student has to come in proper dress code for the Viva Voce
- Questions will be asked to evaluate the reading, speaking and listening skills of the students.
- E-mail and Letter drafting exercises will be given.

Semester IV and V - On Line Objective Examination (Multiple Choice questions)

- 100 questions-100 minutes
- Twenty questions from each UNIT.
- Online examination will be conducted at the end of the IV and V Semester.

3. QUESTION PAPER PATTERN AND MARK DISTRIBUTION

THEORY

Question Paper Pattern and Mark Distribution (For 75 marks)

1. PART - A (10 x 2 = 20 Marks)

Answer ALL questions

Two questions from each UNIT

2. PART - B (5 x 5 =25 Marks)

Answer ALL questions

One question from each UNIT with Internal Choice

3. PART - C (3 x 10 =30 Marks)

Answer ANY THREE questions Open

Choice-3 out of 5 questions

One question from each UNIT

Question Paper Pattern and Mark Distribution (For 100 marks)

1. PART - A (10 x 2 = 20 Marks)

Answer ALL questions

Two questions from each UNIT

2. PART - B (5 x 7 =35 Marks)

Answer ALL questions

One question from each UNIT with Internal Choice

3. PART - C (3 x 15 =45 Marks)

Answer ANY THREE questions

One question from each UNIT

Open Choice - 3 out of 5 questions

One question from each UNIT

DSC Practical Examinations (Maximum marks: 60) Time: 6 Hours

Question paper pattern

Experiment-I (Major)	- 30 Marks
Experiment-II (Minor)	- 15 Marks
Spotters (5 x3)	- 15 Marks
Total	- 60 Marks

SEC PRACTICAL (Maximum marks: 60) Time: 3 Hours

Experiment-I	- 40 Marks
Spotters (5 x4)	- 20 Marks
Total	- 60 Marks

