SOURASHTRA COLLEGE (Autonomous), MADURAI – 4

(A Linguistic Minority Co-educational Institution)

(Affiliated to Madurai Kamaraj University & Re-Accredited with 'B+' Grade by NAAC)

Vilachery Main Road, Pasumalai (P.O), Madurai-625004.

Contact No.: 87542 09994 · sourashtracollege.com

87542 08885 soucollege@gmail.com

NAAC CYCLE IV – SELF STUDY REPORT

Criterion VI	**GOVERNANCE LEADERSHIP AND MANAGEMENT**
Key Indicator 6.5	**Internal Quality Assurance System**
Q_6M 6.5.1	**Internal Quality Assurance Cell (IQAC) has contributed significantly for institutionalizing the quality assurance strategies and processes visible in terms of Incremental improvements made for the preceding five years with regard to quality (in case of first cycle) Incremental improvements made for the preceding five years with regard to quality and post accreditation quality initiatives (Second and Subsequent cycles).**
Year	**2018 – 2023**

NEW PROGRAMMES -M.Sc.MICROBIOLOGY, B.Sc. Computer Science-(CLOUD COMPUTING AND CYBER SECURITY),B.Sc. Computer Science ARTIFICIAL INTELLIGENCE

SOURASHTRA COLLEGE, MADURAI - 625004

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B.Sc. COMPUTER SCIENCE (ARTIFICIAL INTELLIGENCE) - SYLLABUS

(Under CBCS based on OBE) (For those admitted during 2024 - 2025 and after)

ABOUT THE DEPARTMENT

The Department of Computer Science was established during the year 1987–88 with B.Sc. Computer Science Programme. Since then, the Department has been functioning successfully producing young Computer Science graduates every year, with well trained and experienced faculty members and supporting staff. So far, the Department has produced more than 1000 (33 batches) Computer Science graduates and they are all well placed in India & Abroad. The Department has been producing excellent results over a period of 35 years. The Department has adequate infrastructure with a well–equipped Computer Laboratory with LCD Projector, a well stacked Department Library, well– furnished class rooms. From 2023 onwards we have got approval for Artificial Intelligence Programme.

VISION

- Apply a broad understanding of the fundamental theories, concepts, and applications of Computer Science in their career.
- Analyze a multifaceted computing problem and to apply principles of computing and other relevant disciplines to identify solutions and compare alternative solutions to computing problems.
- Apply Computer Science theory and software development fundamentals to produce computing–based solutions.
- To attain an ability to use current techniques, skills, and tools necessary for computing practice.
- To affiance in a wide range of careers and/or graduate studies in computer science or related fields with a zeal for lifelong learning.
- To communicate effectively, both orally and in writing and engaged in collaborative teamwork.
- Recognize the social and ethical errands of a professional working in the discipline**.**

MISSION

The Mission of the Department is to impart computer education to the students in the rural area of Madurai district, so that they become enlightened and intelligent, and to improve the standards of their life, as well as to produce graduates who excel in research and service. We also aim to inculcate the attitudes and values that will motivate them towards the continuous process of learning and leadership. We strive to educate ground–breaking skills and technology for the benefit of learners through incessant upgradation of curriculum.

GRADUATE ATTRIBUTES

1. **(KB) A knowledge base for Computer Science**: Demonstrated competence in university level mathematics, natural sciences, Computer Science fundamentals, and specialized Computer Science knowledge appropriate to the program.
2. **(PA) Problem analysis**: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex Computer Science problems in order to reach substantiated conclusions
3. **(Inv.) Investigation**: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data and synthesis of information in order to reach valid conclusions.
4. **(Des.) Design:** An ability to design solutions for complex, open–ended Computer Science problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. **(Tools) Use of Computer Science tools**: An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern Computer Science tools to a range of Computer Science activities, from simple to complex, with an understanding of the associated limitations.
6. **(Team) Individual and teamwork**: An ability to work effectively as a member and leader in teams, preferably in a multi–disciplinary setting.
7. **(Comm.) Communication skills**: An ability to communicate complex Computer Science concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
8. **(Prof.) Professionalism**: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. **(Impacts) Impact of Computer Science on society and the environment**: An ability to analyze social and environmental aspects of Computer Science activities. Such ability includes an understanding of the interactions that Computer Science has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. **(Ethics) Ethics and equity**: An ability to apply professional ethics, accountability, and equity.
11. **(Econ.) Economics and project management**: An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of Computer Science and to understand their limitations.
12. **(LL) Life–long learning**: An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The **B.Sc. Computer Science (Artificial Intelligence)** Graduates of the Sourashtra College will

PEO 1	attain a professional career by acquiring knowledge in scientific, mathematical, computing, and engineering principles.
PEO 2	apply, analyze, design, optimize, and implement skills to formulate and solve computer science, engineering, and multidisciplinary problems effectively.
PEO 3	utilize fundamental domain knowledge gained from core courses to develop innovative computing solutions, employing creativity and logical reasoning.
PEO 4	provide professional services using the latest technologies in the field of computer science.
PEO 5	cultivate leadership skills while adhering to ethical standards, promoting teamwork, and demonstrating effective communication and time management in the profession.
PEO 6	pursue higher studies, certifications, and research programs in alignment with market demands and emerging trends.

UNDERGRADUATE (UG) PROGRAMME OUTCOMES (POs)

Undergraduate (B.A., **B.Sc.,** B.Com., B.C.A., B.B.A., etc.,) is a 3 – year degree Programme with 6 semesters consisting the following Programme Outcomes (POs) under various criteria including critical thinking, problem solving, effective communication, societal/ citizenship/ ethical credibility, sustainable growth and employable abilities.

PO 1	**Critical Thinking**: Intellectual exploration of knowledge towards actions in clear and rational manner by understanding the logical connections between ideas and decisions.
PO 2	**Problem Solving**: Understanding the task/ problem followed by planning and narrow execution strategy that effectively provides the solution.
PO 3	**Effective Communication**: Knowledge dissemination by oral and verbal mechanisms to the various components of our society.
PO 4	**Societal/ Citizenship/ Ethical Credibility**: Realization of various value systems/ moral dimensions and demonstrate the empathetic social concern as well as equity in all the decisions, executions and actions.
PO 5	**Environmental Concern and Sustainable Growth**: Understanding the emerging environmental challenges and provide the possible contribution in sustainable development that integrates environment, economy and employment.
PO 6	**Skill Development and Employable Abilities**: Adequate training in relevant skill sector and creating employable abilities among the under graduates.

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PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of **B.Sc. Computer Science (Artificial Intelligence) Programme**, the students are expected will be able to

PSO 1	apply basic microeconomic, macroeconomic and monetary concepts and theories in real life and decision making.
PSO 2	be aware of various economic issues related to Development, Growth, International Economics, Sustainable Development and Environment.
PSO 3	be familiar with the concepts and theories related to Finance, Investments and Modern Marketing.
PSO 4	evaluate various social and economic problems in the society and develop answer to the problems as global citizens.
PSO 5	enhance skills of analytical and critical thinking to analyze effectiveness of economic policies.
PSO 6	be ready and willing to embark on new ventures and initiatives, with a focus on critical thinking and a strong desire for continuous learning, particularly in the realm of life skills.

DISTRIBUTION OF CREDITS (UG PROGRAMME)

PART	SEM	COURSES	NO. OF COURSES	HOURS	CREDITS	TOTAL CREDITS
I	I–IV	LANGUAGE	4	6	3	12
II	I–IV	ENGLISH	4	6	3	12
III	I–VI	CORE	16	5–6	4	64
III	I–IV	ALLIED	4	4	4	16
III	V–VI	ELECTIVE	3	5	5	15
IV	I–IV	SKILL BASED SUBJECT	6	2	2	12
IV	I	VALUE EDUCATION	1	2	2	2
IV	I	ENVIRONMENTAL STUDIES	1	2	2	2
IV	III, IV	NON–MAJOR ELECTIVE	2	2	2	4
V	IV	EXTENSION ACTIVITY	1	0	1	1
	V	SELF – STUDY (SOFT SKILLS)	1	0	0	0
	VI	SELF –STUDY (GK (ONLINE))	1	0	0	0
TOTAL						140
Any online courses in SWAYAM PORTAL						

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B.Sc. COMPUTER SCIENCE (ARTIFICIAL INTELLIGENCE)
COURSE STRUCTURE - SEMESTER - I

S. No	Course Code	Subject Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1	24UACT11	**Part – I: Tamil** – ngh**J j** jkpo; – I	6	3	25	75	100	3
	24UACH11	**Hindi** – General Hindi – I						
	24UACS11	**Sanskrit** – Poetry, Grammar and History of Sanskrit Literature						
2	24UACE11	**Part – II: English –** General English – I	6	3	25	75	100	3
3	24UAIC11	**Part – III: Core – 1:** Programming in C	5	3	25	75	100	5
4	24UAICP1	**Part – III: Core – 2: Lab:** C Programming	5	3	40	60	100	3
5	24UAIA11	**Part – III: Allied – 1:** Discrete Mathematical Structures	4	3	25	75	100	4
6	24UAIS11	**Part – IV: SBS – 1:** Digital Principles and Computer Organization	2	3	25	75	100	2
7	24UACVE1	**Part – IV:** Value Education	2	3	25	75	100	2
		TOTAL	**30**				**700**	**22**

SEMESTER - II

S. No	Course Code	Subject Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1	24UACT21	**Part – I: Tamil** – ngh**J j** jkpo; – II	6	3	25	75	100	3
	24UACH21	**Hindi** – General Hindi – II						
	24UACS21	**Sanskrit** – Prose, Grammar and History of Sanskrit Literature						
2	24UACE21	**Part – II: English** – General English – II	6	3	25	75	100	3
3	24UAIC21	**Part – III: Core – 3:** Data Structures and Algorithms	5	3	25	75	100	5
4	24UAICP2	**Part – III: Core – 4: Lab :** Data Structures and Algorithms Using C	5	3	40	60	100	3
5	24UAIA21	**Part – III: Allied – 2:** Probability and Statistics	4	3	25	75	100	4
6	24UAIS21	**Part – IV: SBS – 2:** Foundations of Artificial Intelligence	2	3	25	75	100	2
7	24UACES1	**Part– IV:** Environmental Studies	2	3	25	75	100	2
		TOTAL	**30**				**700**	**22**

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SEMESTER – V

S. No	Course Code	Subject Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1		**Part – I:Tamil** – fhg;gpaKk ehLfKk;	6	3	25	75	100	3
		Hindi – Hindi – III						
		Sanskrit – Sanskrit – III						
2		**Part – II: English** – English For Enrichment – III	6	3	25	75	100	3
3		**Part – III: Core – 5:** Object Oriented Programming Using C++	5	3	25	75	100	5
4		**Part – III: Core – 6: Lab:** Object Oriented Programming Using C++	5	3	40	60	100	3
5		**Part – III: Allied – 3:** Resource Management Techniques	4	3	25	75	100	4
6		**Part – IV: SBS – 3: Lab:** Linux and Shell Programming	2	3	40	60	100	2
7		**Part – IV: NME – 1:** Office Automation	2	3	25	75	100	2
		TOTAL	**30**				**700**	**22**

SEMESTER - IV

S. No	Course Code	Subject Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1		**Part – I: Tamil** – rq;f ,yf;fpaKk mw ,yf;fpaKk	6	3	25	75	100	3
		Hindi – Hindi – IV						
		Sanskrit – Sanskrit – IV						
2		**Part – II: English** – English For Enrichment – IV	6	3	25	75	100	3
3		**Part – III: Core – 7:** Programming in Java	5	3	25	75	100	5
4		**Part – III: Core – 8: Lab:** Java Programming	5	3	40	60	100	3
5		**Part – III: Allied – 4:** Numerical Methods	4	3	25	75	100	4
6		**Part – IV: SBS – 4: Lab:** SQL Programming	2	3	40	60	100	2
7		**Part – IV: NME – 2:** Introduction to Internet	2	3	25	75	100	2
8		**Part–V:** Extension Activities	–	–	–	–	100	1
		TOTAL	**30**				**800**	**23**

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SEMESTER – V

S. No	Course Code	Subject Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1		**Part – III: Core – 9:** Software Engineering	5	3	25	75	100	4
2		**Part – III: Core – 10:** Operating System Concepts	5	3	25	75	100	4
3		**Part – III: Core – 11:** Machine Learning	5	3	25	75	100	4
4		**Part – III: Core – 12:** **Lab :** Machine Learning Lab – I	6	3	40	60	100	4
5	**Part – III: Elective – 1***		5	3	25	75	100	5
		Principles of Deep Learning						
		Computing Intelligence						
		Pattern Recognition						
		Soft Computing						
6		**Part – IV: SBS – 5:** Quantitative Aptitude	2	3	25	75	100	2
7		**Part – IV: SBS – 6:** **Lab :** Web Design	2	3	40	60	100	2
8		Soft Skills (Self–Study)	–	–	–	–	100	–
		TOTAL	**30**				**800**	**25**

***One elective course to be chosen from FOUR courses**

SEMESTER – VI

S. No	Course Code	Subject Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1		**Part – III: Core – 13:** IoT and Cloud Technologies	5	3	25	75	100	5
2		**Part – III: Core – 14:** Artificial Intelligence	5	3	25	75	100	5
3		**Part – III: Core – 15:** **Lab :** Machine Learning Lab II	5	3	40	60	100	3
4		**Part – III: Core – 16:** **Lab:** Natural Language Processing	5	3	40	60	100	3
5	**Part – III: Elective – 2***		5	3	25	75	100	5
		Natural Language Processing						
		Simulation and Modelling						
		Robotics and Applications						
		Neural Networks						
6		**Part – III: Elective – 3:** Project & Viva–Voce	5	3	40	60	100	5
7		General Knowledge (Self–Study)	–	–	–	–	100	–
		TOTAL	**30**				**700**	**26**

***One elective course to be chosen from FOUR courses**

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COURSE STRUCTURE - I SEMESTER

S. No	Course Code	Subject Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1	24UACT11	**Part – I: Tamil** – nghJj jkpo – I	6	3	25	75	100	3
	24UACH11	**Hindi** – General Hindi – I						
	24UACS11	**Sanskrit** – Poetry, Grammar and History of Sanskrit Literature						
2	24UACE11	**Part – II: English –** General English – I	6	3	25	75	100	3
3	24UAIC11	**Part – III: Core – 1:** Programming in C	5	3	25	75	100	5
4	24UAICP1	**Part – III: Core – 2: Lab:** C Programming	5	3	40	60	100	3
5	24UAIA11	**Part – III: Allied – 1:** Discrete Mathematical Structures	4	3	25	75	100	4
6	24UAIS11	**Part – IV: SBS – 1:** Digital Principles and Computer Organization	2	3	25	75	100	2
7	24UACVE1	**Part – IV:** Value Education	2	3	25	75	100	2
		TOTAL	**30**				**700**	**22**

CA – Class Assessment (Internal)

SE – Summative Examination

SBS – Skill Based Subject

NME – Non –Major Elective

T – Theory

P – Practical

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COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24UAIC11	PROGRAMMING IN C	CORE – 1	5	–	5

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship
	✓	✓	

COURSE DESCRIPTION:

This course helps to provide the fundamental knowledge of a programming language and its features which enhances the user to write general purpose application programs.

COURSE OBJECTIVES:

- To inculcate fundamental knowledge of programming
- To develop programming skills using the fundamentals and basics of C language
- To stress the importance of clarity, simplicity and the efficiency in writing programs

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	apply the basic concepts and develop program to find solutions for simple problems	Upto K3
CO 2	design programs to solve complex problems by using suitable control statements	Upto K3
CO 3	analyze the problem and design efficient program using functions	Upto K3
CO 4	use array and structure to handle volume of data	Upto K3
CO 5	use advanced data structures pointers and files for data processing	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY

PROGRAMMING IN C

UNIT – I:

C fundamentals: Character set – Identifier and keywords – data types –constants – Variables – Declarations – Expressions – Statements – Arithmetic, Unary, Relational and logical, Assignment and Conditional Operators – Library functions.

UNIT – II:

Data input output functions – Simple C programs – Flow of control – if, if–else, while, do–while, for loop, Nested control structures – Switch, break and continue, go to statements – Comma operator.

UNIT – III:

Functions: Definition – proto type – Passing arguments – Recursions. Storage Classes: Automatic, External, Static, Register Variables – Multi–file programs – Preprocessor directives – Macro substitution – File inclusion – Compiler Control Directives.

UNIT – IV:

Arrays: Defining and processing – Passing arrays to functions – Multi– dimension arrays – Arrays and String. Structures: User defined data types – Passing structures to functions – Self–referential structures – Union – Bit wise operations.

UNIT – V:

Pointers: Declarations – Passing pointers to Functions – Operation in Pointers– Pointer and Arrays – Arrays of Pointers – Structures and Pointers – Files: Sequential and random file Creation and Processing – Command line arguments.

TEXT BOOK:

E. Balagurusamy, ***Programming in ANSI C***, 7th Edition, Tata McGraw Hill, 2017.

REFERENCE BOOKS:

1. B.W. Kernighan and D. M. Ritchie, ***The C Programming Language***, 2nd Edition, PHI, 1988.
2. H. Schildt, ***C: The Complete Reference***, 4th Edition. TMH Edition, 2000.
3. Gottfried B.S, ***Programming with C***, Second Edition, TMH Pub. Co. Ltd., New Delhi1996.
4. Kanetkar Y., ***Let us C***, BPB Pub., NewDelhi,1999.

DIGITAL TOOLS:

1. http://www.kciti.edu/wp–content/uploads/2017/07/cprogramming_tutorial.pdf
2. https://www.skiet.org/downloads/cprogrammingquestion.pdf
3. https://phy.ntnu.edu.tw/~cchen/pdf/ctutor.pdf

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	2	1	1	3
CO2	2	2	1	1	1	1
CO3	1	1	2	3	1	1
CO4	1	3	1	1	1	3
CO5	1	1	2	2	2	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. T. D.VENKATESWARAN

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COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24UAICP1	LAB: C PROGRAMMING	CORE–2 LAB	–	5	3

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	40	60	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship
	✓	✓	✓

COURSE DESCRIPTION:

This course helps to provide the fundamental knowledge of a programming language and its features which enhances the user to write general purpose application programs.

COURSE OBJECTIVES:

- To inculcate fundamental knowledge of programming.
- To develop programming skills using the fundamentals and basics of C language.
- To stress the importance of clarity, simplicity and the efficiency in writing programs.
- It aims to train the student to the basic concepts of the C–programming language.
- To improve the programming skills through C language.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	demonstrate the understanding of syntax and semantics of c programs.	Upto K3
CO 2	identify the problem and solve using c programming techniques.	Upto K3
CO 3	identify suitable programming constructs for problem solving.	Upto K3
CO 4	analyze various concepts of c language to solve the problem in an efficient way.	Upto K3
CO 5	develop a C program for a given problem and test for its correctness.	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY

LAB: C PROGRAMMING

LIST OF EXPERIMENTS:

Expression Evaluation

1. Finding Simple Interest and Compound Interest
2. Centigrade to Fahrenheit and Fahrenheit to Centigrade
3. Finding roots of a quadratic equation
4. Finding Standard Deviation and Variance

Conditional Statements

1. EB Bill Generation
2. Print Grade of a student
3. Checking Prime Number, Perfect Number, Armstrong Number, Adam Number
4. Sum of the digits of a number

Summation of Series

1. Sin(x), 2. Cos(x), 3. Exp(x) (Comparison with built in functions)

String Manipulation

1. Counting the number of vowels, consonants, words, white spaces in a line of text and array of lines.
2. Reverse a string and check for palindrome.
3. Sub string detection, count and removal.
4. Finding and replacing substrings.

Functions

1. Finding Factorial
2. Finding NCP value using recursion
3. Finding biggest element

Recursion

1. ${}^{n}P_{r}, {}^{n}C_{r}$
2. GCD of two numbers
3. Fibonacci sequence
4. Maximum & Minimum

Matrix Manipulation

1. Addition and Subtraction
2. Multiplication
3. Transpose, and trace of a matrix
4. Determinant of a Matrix

Structures

1. Mark Sheet Preparation using structure
2. Paybill Preparation using structure

Preprocessor Directives

Simple programs using Preprocessor Directives

Files

1. Inventory Control
2. Library Management

COURSE DESIGNER: Dr. T.D.VENKATESWARAN

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24UAIA11	DISCRETE MATHEMATICAL STRUCTURES	ALLIED – 1	4	–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability	✓	Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course helps to provide the fundamental knowledge of Discrete structures like Set theory, Relations, Functions, Matrices, Logic, Graph Theory

COURSE OBJECTIVES:

- To teach the basic concepts of set theory.
- To impart knowledge on solving problems using logic.
- To understand the mathematical concepts of combinatory.
- To solve various problems in number theory.
- To study the basic concepts of relations and its applications.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	gain knowledge on set theory.	Upto K3
CO 2	understand different mathematical logics and functions.	Upto K3
CO 3	get an idea on permutations and combinations.	Upto K3
CO 4	understand the different form of number theory.	Upto K3
CO 5	understand relations and its applications.	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLICATION

DISCRETE MATHEMATICAL STRUCTURES

UNIT– I: SET THEORY

Introduction– set and its Element – Set Description (Roster, Set Builder and cardinal number method) Types of Sets– Set Operations and Laws of set Theory. Partition of sets. Minsets– Countable and uncountable set. Algebra of sets and Duality.

UNIT– II: MATHEMATICAL LOGIC

Basic Logic and Proof, logical operations – Logic Propositional equivalence, Predicates and Quantities, Tautology–Contradiction–Methods of proofs(Direct and Indirect)– Function–Definition–Notation– Types of Function– Composition of Functions.

UNIT– III: NUMBER THEORY

The Integers and Division, Integers and Algorithms, (Multiplication, Addition and Division –Sequences and Summations, Recursive algorithms, Program correctness

UNIT– IV: COMBINATORICS

The basics of counting, the pigeonhole principle, Permutations and Combinations, Binomial coefficients, Generalized permutations and combinations

UNIT– V: RELATIONS

Relations – Relations and their properties, Representing Relations, Closures of relations, Equivalence relations, Partial orderings – Recurrence Relations Binary Relations.

TEXT BOOKS:

1. Rosen K.H. ***Discrete Mathematics and its Applications***, 5th edition, Tata McGraw – Hills, 2003.
2. J.K Sharma, ***Discrete Mathematics,*** 3rd Edition, Macmillan Reprint 2011.

REFERENCE BOOK:

Modern Algebra, S. Arumugam & A. Thangapandi Issac, Scitech publications, 2005

DIGITAL TOOLS:

1. https://www.coursera.org/specializations/discrete–mathematics
2. https://www.javatpoint.com/discrete–mathematics–tutorial
3. https://medium.com/basecs/a–gentle–introduction–to–graph–theory–7969829ead8

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	2	1	1	3
CO2	2	2	1	1	1	1
CO3	1	1	2	3	1	1
CO4	1	3	1	1	1	3
CO5	1	1	2	2	2	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Prof. S. K. GANESHBABU

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24UAIS11	DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION	SBS – 1	2	–	2

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship
	✓	✓	

COURSE DESCRIPTION:

The course enables the students to design digital circuits using basic logic gates and to understand concepts of sequential combinational circuits. The students gain the knowledge and understand hardware components of a computer and impart knowledge about internal architecture of a computer system.

COURSE OBJECTIVES:

- To give knowledge about basic number systems like Binary, Octal, Decimal, Hexadecimal number system.
- To give knowledge on the physical internal components of computers like Multiplexers, Decoders, Encoders, Flipflops, Registers and Counters.
- To make them understand the basic structure and operation of a digital computer.
- To teach the design of data path unit, control unit for processor and to familiarize with the hazards.
- To make them understand the concept of various memories and I/O interfacing.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	explore number system and logic gates.	Upto K3
CO 2	design various combinational and sequential digital circuits using logic gates.	Upto K3
CO 3	state the fundamentals of computer systems and analyze the execution of an instruction.	Upto K3
CO 4	analyze different types of control design and identify hazards.	Upto K3
CO 5	identify the characteristics of various memory systems and I/O communication.	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY

DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION

UNIT – I:

Binary number system – Binary to Decimal conversions–Decimal to Binary–Octal–Hexadecimal numbers – ASCII code –Excess–3 code – The basic gates – Inverter– OR Gates–AND Gates– Universal logic gates – NOR Gates – NAND Gates.

UNIT – II:

Combinational Circuits – Karnaugh Map – Analysis and Design Procedures – Binary Adder – Subtractor – Decoder – Encoder – Multiplexers –Demultiplexers.

Introduction to Sequential Circuits – Flip–Flops and its types – operation and excitation tables – Registers and types – Counters and its types.

UNIT – III:

Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding of Machine Instruction – Interaction between Assembly and High Level Language.

UNIT – IV:

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control – Pipelining – Data Hazard – Control Hazards.

UNIT – V:

Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O.

TEXT BOOK:

Digital Principles and Application, Albert Paul Malvino and Donald P. Leach, Sixth Edition, Tata McGraw–Hill–Education, 2006.

Computer System Architecture, M. Morris Mano, 3rd Edition, 2007, Pearson, New Delhi.

REFERENCE BOOKS:

1. ***Digital Computer Fundamentals***, by Thomas C.Bartee TMH 2007.
2. ***Digital Circuits and Design***, by S.Salivahanan and S.Arivazhagan ,Vikas Publishers.2005.
3. ***Computer Organization,*** by V. Carl Hamacher, Zconko G. Vranesic, Safwat G. Zaky 4th Edition, McGraw–Hill International Editions.

DIGITAL TOOLS:

1. https://www.mheducation.co.in/digital–principles–and–applications–sie–9789339203405–india
2. http://jnujprdistance.com/assets/lms/LMS%20JNU/B.Sc.(IT)/Sem%20I/Digital%20Computer%20Fundamentals/Version%201/Digital%20Computer%20Fundamentals.pdf

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	1	2	–
CO2	2	2	1	2	2	–
CO3	2	1	–	1	1	–
CO4	2	1	2	2	2	1
CO5	2	2	1	1	1	–

3. Advanced Application Level **2. Intermediate Development** **1. Introductory**

COURSE DESIGNER: Dr. K. ANURATHA

SOURASHTRA COLLEGE, MADURAI - 625004

(An Autonomous Institution Re-accredited with 'B+' grade by NAAC)

B.Sc. COMPUTER SCIENCE (ARTIFICIAL INTELLIGENCE) - SYLLABUS

(Under CBCS based on OBE) (For those admitted during 2024 - 2025 and after)

COURSE STRUCTURE - II SEMESTER

S. No	Course Code	Subject Title	Hrs. / Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1	24UACT21	**Part – I: Tamil** – nghJj jkpo – II	6	3	25	75	100	3
	24UACH21	**Hindi** – General Hindi – II						
	24UACS21	**Sanskrit** – Prose, Grammar and History of Sanskrit Literature						
2	24UACE21	**Part – II: English** – General English – II	6	3	25	75	100	3
3	24UAIC21	**Part – III: Core – 3:** Data Structures and Algorithms	5	3	25	75	100	5
4	24UAICP2	**Part – III: Core – 4: Lab :** Data Structures and Algorithms Using C	5	3	40	60	100	3
5	24UAIA21	**Part – III: Allied – 2:** Probability and Statistics	4	3	25	75	100	4
6	24UAIS21	**Part – IV: SBS – 2:** Foundations of Artificial Intelligence	2	3	25	75	100	2
7	24UACES1	**Part– IV:** Environmental Studies	2	3	25	75	100	2
		TOTAL	**30**				**700**	**22**

CA – Class Assessment (Internal)

SE – Summative Examination

SBS – Skill Based Subject

NME – Non –Major Elective

T – Theory

P – Practical

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24UAIC21	DATA STRUCTURES AND ALGORITHMS	CORE – 3	5	–	5

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship
	✓	✓	

COURSE DESCRIPTION:

This course aims to impart fundamental knowledge to organize and structure data to the design and implementation of efficient algorithms and program development. And also learn on application of data structures in problem solving using several predefined algorithms.

COURSE OBJECTIVES:

- To impart knowledge and skill on identifying apt data structures to solve problems efficiently.
- To impart skill to write time and space efficient algorithms.
- To give knowledge on the concepts and applications of (i) linear data structures viz., arrays, stacks, queues (ii) linked linear data structures viz., linked lists, linked stacks and linked queues and (iii) Non–linear data structures viz.,trees, binary trees
- To give knowledge on various sorting and searching algorithms
- To impart knowledge on solving problems using algorithmic techniques viz., Divide and Conquer, Greedy Approach

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	identify data structures needed to solve specific problems	Upto K3
CO 2	analyze the data structures for effective use in problem solving	Upto K3
CO 3	design and develop efficient algorithms in terms of Space and Time	Upto K3
CO 4	troubleshoot algorithms	Upto K3
CO 5	analyze time complexity of algorithms	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY

DATA STRUCTURES AND ALGORITHMS

UNIT– I:

Introduction – Basic Terminology; Elementary data organization – Data structure operations – Complexity of algorithms – other asymptotic notations for complexity of algorithms

Arrays – Introduction – Linear Arrays – Representation of Linear Arrays in memory – Traversing Linear Arrays –Inserting and Deleting – Searching – Linear Search, binary Search – Multi dimensional arrays

UNIT–II:

Linked List – Introduction – Representation on Linked list in memory – Traversing a linked list – searching in a linked list – **Memory Allocation**: Garbage Collection – Inserting into a linked list – Deletion from a linked list

UNIT–III:

Stack: Introduction – Array representation of stacks – Linked list representation of stacks – **Arithmetic Expression** : Polish Notation – Evaluation of a Postfix expression – transforming infix expression to postfix expression – **Recursio**n : Factorial , Fibonacci – Towers of Hanoi. **Queue** – Linked Representation of Queues – DeQueue

UNIT–IV:

Trees – Binary Trees – Representing binary trees in memory – Traversing binary trees – Binary Search Trees – Searching and inserting in binary search trees – deleting a binary search tree

Algorithms – Introduction– What is an Algorithm – Algorithms Specification – Performance Analysis

Divide and Conquer – General Method – Binary Search – Finding the maximum and Minimum – Merge Sort – Quick Sort – Selection

UNIT–V:

The Greedy Method – General Method – Knapsack problem – Job sequencing with deadlines – **Minimum cost spanning tree**: Prim's Algorithm – Kruskal Algorithm – Optimal Storage on tapes – optimal merge patterns – single source shortest path

TEXT BOOKS:

1. ***Data Structures*** by Seymour Lipschutz, Schaum's outlines, Tata McGraw Hill Education Private Limited, New Delhi. 2006.
2. ***Fundamentals of Computer Algorithms***, Ellis Horowitz, Sartaj Shani, Galgotia publications Pvt Ltd, 2010, New Delhi.

REFERENCE BOOKS:

1. ***Data structures Using C*** Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, Kindersley (India) Pvt. Ltd., 2009.
2. ***Data structures and Algorithms***, Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, Pearson Education Pvt.Ltd., 2002.

DIGITAL TOOLS:

1. https://www.computer–pdf.com/programming/781–tutorial–data–structure–and–algorithm–notes.html
2. https://www.cs.princeton.edu/courses/archive/spr11/cos247/lectures/08DsAlg.pdf
3. https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_DS_LECTURE_NOTES_2.pdf

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	**1**	**1**	**1**	**1**	**1**	**2**
CO2	**2**	**2**	**1**	**2**	**1**	**3**
CO3	**3**	**2**	**1**	**1**	**2**	**2**
CO4	**2**	**1**	**2**	**2**	**2**	**3**
CO5	**1**	**1**	**1**	**1**	**1**	**1**

3. Advanced Application Level **2. Intermediate Development** **1. Introductory**

COURSE DESIGNER: Prof. D. V. JEYANTHI

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24UAICP2	LAB: DATA STRUCTURES AND ALGORITHMS USING C	CORE – 4 LAB	5	–	3

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	40	60	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship
	✓	✓	✓

COURSE DESCRIPTION:

This course aims to impart fundamental knowledge to organize and structure data to the design and implementation of efficient algorithms and program development. And also learn on application of data structures in problem solving using several predefined algorithms.

COURSE OBJECTIVES:

- To understand the concepts of Linked List, Stack and Queue, Trees and Graphs.
- To Perform traversal operations on Trees and Graphs. To enable the applications of Trees and Graphs.
- To apply searching and sorting techniques
- To determine the concepts of Greedy Method
- To apply searching techniques.
- To give knowledge on various sorting and searching algorithms

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	understand and implement data structures using C	Upto K3
CO 2	understand and implement various types of linked lists and their applications	Upto K3
CO 3	understand and implement Tree Traversals	Upto K3
CO 4	understand and implement various algorithms in C	Upto K3
CO 5	understand and implement different sorting and searching algorithms	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY

LAB: DATA STRUCTURES AND ALGORITHMS USING C

LIST OF EXPERIMENTS

1. Perform stack operations
2. Perform queue operations
3. Perform tree traversal operations
4. Search an element in an array using linear search.
5. Search an element in an array using binary search
6. Sort the given set of elements using Merge Sort.
7. Sort the given set of elements using Quick sort.
8. Search the Kth smallest element using Selection Sort
9. Find the Optimal solution for the given Knapsack Problem using Greedy Method.
10. Find all pairs shortest path for the given Graph using Dynamic Programming method
11. Find the Single source shortest path for the given Travelling Salesman problem using Dynamic Programming method
12. Find all possible solution for an N Queen problem using backtracking method
13. Find all possible Hamiltonian Cycle for the given graph using backtracking method

COURSE DESIGNER: Dr. K. ANURATHA

SOURASHTRA COLLEGE, MADURAI - 625004

(An Autonomous Institution Re-accredited with 'B+' grade by NAAC)

B.Sc. COMPUTER SCIENCE
(ARTIFICIAL INTELLIGENCE) - SYLLABUS

(Under CBCS based on OBE) (For those admitted during 2024 - 2025 and after)

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24UAIA21	PROBABILITY AND STATISTICS	ALLIED – 2	4	–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship
	✓	✓	

COURSE DESCRIPTION:

This course helps to provide the fundamental knowledge about Probability & Statistics

COURSE OBJECTIVES:

- To give knowledge about various types of statistical measures such as mean, median, mode, geometric mean, harmonic mean, standard deviation etc.,
- To give a foundation in statistical data analysis
- To solve real life problems using Correlation coefficient, regression, and theoretical probability distributions.

COURSE OUTCOMES (CO):

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

No.	Course Outcome	Knowledge Level (According to Bloom's Taxonomy)
CO 1	identify the basic concepts Central tendencies	Upto K3
CO 2	gain knowledge about Measures of Dispersion	Upto K3
CO 3	receive the idea of Curve Fitting, Correlation & Regression	Upto K3
CO 4	get knowledge about the basic concepts of Probability & Random variables	Upto K3
CO 5	acquire knowledge about theoretical Discrete & Continuous distributions	Upto K3

K1– KNOWLEDGE(REMEMBERING), K2–UNDERSTANDING, K3–APPLICATION

PROBABILITY AND STATISTICS

UNIT – I:

Introduction to statistics – primary and secondary data – classification, tabulation and Diagrammatic Representation of statistical data – Bar–charts, Pie–diagrams – Graphical Representation of data – Histograms, Frequency polygon, Ogives.

UNIT – II:

Measures of dispersion – characteristics – coefficient of dispersion – Coefficient of variation–Moments – skewness and kurtosis – Pearson's coefficient of skewness – Bowley's coefficient of Skewness – Coefficient of skewness based upon moments.

UNIT – III:

Simple correlation – Karl Pearson's coefficient of correlation – correlation coefficient for A bivariate frequency distribution – Rank correlation – Regression lines of regression – Properties of regression coefficient.

UNIT – IV:

Events and sets – sample space – concept of probability – addition and multiplications Theorem on probability – conditional probability and independence of evens – Baye's Theorem – concept of random variable – Mathematical Expectation.

UNIT –V:

Concept of sampling distributions – standard error – Tests of significance based on t, Chi–square and F distributions with respect to mean, variance.

TEXT BOOK:

Statistical Methods, S.P. Gupta, Sultan Chand and sons Publications, 4th Edition 2011.

REFERENCE BOOKS:

1. ***Fundamentals of Mathematical Statistics*** by S.C. Gupta & V.K. Kapoor, Sultan Chand and Sons, 2004.
2. ***Elements of Mathematical Statistics*** By S.C. Gupta & V.K. Kapoor, Sultan Chand & Sons, Third Edition, 2000

DIGITAL TOOLS:

1. http://math.iisc.ernet.in/~manju/UGstatprob16/statprob.pdf
2. http://wwwf.imperial.ac.uk/~ejm/ISE.2.6/NOTES.PDF

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	2	1	1	3
CO2	2	2	1	1	1	1
CO3	1	1	2	3	1	1
CO4	1	3	1	1	1	3
CO5	1	1	2	2	2	2

3. Advanced Application Level **2. Intermediate Development** **1. Introductory**

COURSE DESIGNER: Prof. S. K. GANESHBABU

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24UAIS21	FOUNDATIONS OF ARTIFICIAL INTELLIGENCE	SBS – 2	2	–	2

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability	✓	Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course aims to introduce the fundamental concepts of artificial intelligence (AI). Students will develop a broad understanding of AI technologies, their implications, and their potential applications in various fields. The course will emphasize practical examples and real–world case studies to facilitate comprehension and inspire innovative thinking.

COURSE OBJECTIVES:

To make the students

- Learn the basic representation and reasoning paradigms used in AI.
- Understand the subfields of AI.
- Explore real–world applications of AI across different industries.
- Gain insights into the ethical, social, and economic implications of AI.
- Provide an introduction to the underlying issues and future directions.

COURSE OUTCOMES (COs):

On the successful completion of the course, students will be able to

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	define the fundamental concepts of AI.	Upto K3
CO 2	explain the subfields of AI.	Upto K3
CO 3	identify real–world applications of AI across various industries.	Upto K3
CO 4	analyze the ethical, social, and economic implications of AI.	Upto K3
CO 5	recognize the potential of AI to drive innovation and transformation in different domains.	Upto K3

K1– KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY

FOUNDATIONS OF ARTIFICIAL INTELLIGENCE

UNIT I:

Introduction to Artificial Intelligence – Definition and scope of AI – Historical overview and key milestones – Differentiating AI from human intelligence.

UNIT II:

AI Subfields and Technologies: Machine learning: Supervised, unsupervised, and reinforcement learning – Deep learning and neural networks – Natural language processing (NLP) and computer vision

UNIT III:

Applications of AI: AI in healthcare: Diagnosis, treatment, and medical imaging – AI in finance: Fraud detection, algorithmic trading, and risk assessment – AI in transportation: Autonomous vehicles and traffic optimization – AI in customer service and chatbots – AI in education: Personalized learning and intelligent tutoring systems.

UNIT IV:

Ethical and Social Implications of AI: Bias and fairness in AI systems – Privacy and data protection concerns – Impact of AI on employment and the workforce – AI and social inequality.

UNIT V:

Other Important Issues: Ethical guidelines and responsible AI practices – AI and Innovation – Emerging trends and future directions in AI – AI and creativity: Generative models and artistic applications.

TEXT BOOK:

Foundations of Artificial Intelligence, Digital Lecture Notes provided by the department.

REFERENCE BOOK:

1. Stuart Russell and Peter Norvig, ***Artificial Intelligence: A Modern Approach,*** 3rd Edition, Prentice Hall, 2010.
2. Nils J Nilsson, ***Principles of Artificial Intelligence***, Illustrated Reprint Edition, Springer Heidelberg, 2014.
3. Patrick Henry Winston, ***Artificial Intelligence***, Third Edition, Addison–Wesley Publishing Company, 2004.

DIGITAL TOOLS:

- https://nptel.ac.in/courses/106102220
- https://www.udemy.com/course/learn–basics–of–artificial–intelligence/
- https://www.ibm.com/topics/artificial–intelligence

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	2	1	1	2
CO2	2	2	1	1	1	1
CO3	1	1	2	2	1	1
CO4	1	2	1	1	1	2
CO5	1	1	2	2	2	2

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE DESIGNER: Dr. K. ANURATHA

SOURASHTRA COLLEGE, MADURAI - 625004

(An Autonomous Institution Re-accredited with 'B+' grade by NAAC)

B.Sc. COMPUTER SCIENCE (CLOUD COMPUTING AND CYBER SECURITY) - SYLLABUS

(Under CBCS based on OBE) (with effect from 2023 - 2024)

DEPARTMENT PROFILE:

The Department of Computer Science was established in the year 1987 – 88 with B.Sc. Computer Science programme. Then it was initiated in the Self– Finance Stream in the year 1997 – 1998. The Department has been producing young graduates and they are well – placed in India and abroad. Cloud computing is powerful and expansive and will continue to grow in the future and provide many benefits. Cloud technologies include artificial intelligence, machine learning, edge computing, virtual desktops, automation, SASE, and disaster recovery. Cyber Security is the intricate practice of protecting systems, mobile devices, data, networks, and programs from cyber– attacks, or any unauthorized access. So, **B.Sc. Computer Science with Cloud Computing and Cyber Security** is started in the academic year 2023 – 2024. The Department has adequate infrastructure with a well– equipped Computer Laboratory, a well stacked Department Library, well– furnished class rooms, a separate room for power point presentation with a LCD Projector.

VISION:

To Ignite and nurture young learners to provide a sustainable, humane, and research–centric educational platform in the domain of Cloud Computing and Cyber Security for building a robust, resilient, and attack– free digital universe.

MISSION:

- To provide committed and competent faculty and educational infrastructure to impart the theoretical and practical foundation of Cloud Computing and Cyber Security in the emanating youth.
- To provide industry– ready graduates with research instinct imbibed for the sustainable development of young learners
- To build collaborative and teamwork– centric project– oriented learning environment, to address global challenges whilst preserving human and ethical values.
- To encourage young minds to educate society to restore nationwide human safety and security in digital world.

DISTRIBUTION OF CREDITS (UG PROGRAMME)

PART	SEM	COURSES	NO.OF COURSES	HOURS	CREDITS	TOTAL CREDITS
I	I-IV	LANGUAGE	4	6	3	12
II	I-IV	ENGLISH	4	6	3	12
III	I-VI	CORE	17	4-6	3-4	66
III	I-IV	ALLIED	4	4	4	16
III	V, VI	ELECTIVE	3	5	4-5	13
IV	I-IV	SKILL BASED SUBJECT(SBS)	6	2	2	12
IV	I	VALUE EDUCATION	1	2	2	2
IV	II	ENVIRONMENTAL STUDIES	1	2	2	2
IV	III, IV	NON-MAJOR ELECTIVE(NME)	2	2	2	4
V	IV	EXT. ACTIVITY	1	0	1	1
TOTAL CREDITS						**140**

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	To make the students successful in their professional careers, including entrepreneurship using their knowledge in Computer Science and Applications.
PEO 2	To help the students continue to learn and adopt latest technologies to solve real life problems.
PEO 3	To motivate the students pursue research and higher education.
PEO 4	To inculcate in students professional and ethical attitude, communication skills, teamwork skills, multi – disciplinary approach and an ability to relate computer Science issues with social awareness.
PEO 5	To prepare students to excel in post graduate programmes in Computer Science or to succeed in computing industry profession through quality education.

UNDERGRADUATE (UG) PROGRAMME OUTCOMES (POs)

Undergraduate (B.A., **B.Sc.,** B.Com., B.C.A., B.B.A., etc.,) is a 3– year degree programme with 6 semesters consisting the following Programme Outcomes (POs) under various criteria including critical thinking, problem solving, effective communication, societal/ citizenship/ ethical credibility, sustainable growth and employable abilities.

PO 1	**Critical Thinking**: Intellectual exploration of knowledge towards actions in clear and rational manner by understanding the logical connections between ideas and decisions.
PO 2	**Problem Solving**: Understanding the task/ problem followed by planning and narrow execution strategy that effectively provides the solution.
PO 3	**Effective Communication**: Knowledge dissemination by oral and verbal mechanisms to the various components of our society.
PO 4	**Societal/ Citizenship/ Ethical Credibility**: Realization of various value systems/ moral dimensions and demonstrate the empathetic social concern as well as equity in all the decisions, executions and actions.
PO 5	**Environmental Concern and Sustainable Growth**: Understanding the emerging environmental challenges and provide the possible contribution in sustainable development that integrates environment, economy and employment.
PO 6	**Skill Development and Employable Abilities**: Adequate training in relevant skill sector and creating employable abilities among the under graduates.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of **B.Sc. Computer Science (Cloud Computing and Cyber Security)** Programme, the students are expected to

PSO 1	think in a critical and logical based manner. Equip with Computer science technical ability, problem solving skills, creative talent and power of communication necessary for various forms of employment
PSO 2	become familiar with suitable software tools of Computer Science and industrial applications to handle issues and solve problems in Mathematics or Statistics and real– time application related sciences.
PSO 3	know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand.
PSO 4	understand, formulate, develop programming model with logical approaches to and address issues arising in social science, business and other contexts.
PSO 5	acquire good knowledge and understanding to solve specific theoretical and applied problems in advanced areas of Computer science and Industrial statistics, get adequate exposure to global and local concerns that provides platform for further exploration into multi– dimensional aspects of Computing sciences.
PSO 6	receive sufficient knowledge and skills enabling them to undertake further studies in Computer Science or Applications or Information Technology and its allied areas on multiple disciplines linked with Computer Science, develop a range of generic skills helpful in employment, internships & societal activities.

SOURASHTRA COLLEGE, MADURAI - 625004

(An Autonomous Institution Re-accredited with 'B+' grade by NAAC)

B.Sc. COMPUTER SCIENCE (CLOUD COMPUTING AND CYBER SECURITY) - SYLLABUS

(Under CBCS based on OBE) (with effect from 2023 - 2024)

B.Sc. COMPUTER SCIENCE
(CLOUD COMPUTING AND CYBER SECURITY) - I YEAR
COURSE STRUCTURE - I SEMESTER

S No	CODE	Subject	Hrs./ Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1.	21UACT11	**Part – I: Tamil** – ftpijAk; rpWfijAk	6	3	25	75	100	3
	21UACH11	**Hindi** – Hindi – I						
	21UACS11	**Sanskrit** – Sanskrit – I						
2.	21UACE11	**Part – II: English** – English For Enrichment – I	6	3	25	75	100	3
3.	23UCDC11	**Part – III: Core – 1:** Programming in C	4	3	25	75	100	4
4.	23UCDCP1	**Part – III: Core – 2:** **Lab – I**: Programming in C	6	3	40	60	100	4
5.	23UCDA11	**Part – III: Allied – 1:** Mathematical Foundations – I	4	3	25	75	100	4
6.	23UCDS11	**Part – IV:SBS – 1:Lab– II:** PC Assembling, Trouble Shooting and System Management	2	3	40	60	100	2
7.	21UACVE1	**Part – IV:** Value Education	2	3	25	75	100	2
	Total		30				700	22

COURSE STRUCTURE - II SEMESTER

S No	CODE	Subject	Hrs./ Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1.	21UACT21	**Part – I: Tamil** – nra;ASk GjpdKk	6	3	25	75	100	3
	21UACH21	**Hindi** – Hindi – II						
	21UACS21	**Sanskrit** – Sanskrit – II						
2.	21UACE21	**Part – II: English** – English For Enrichment – II	6	3	25	75	100	3
3.	23UCDC21	**Part – III: Core – 3:** Java Programming	4	3	25	75	100	4
4.	23UCDCP2	**Part – III: Core – 4:** **Lab – III**: Java Programming	6	3	40	60	100	4
5.	23UCDA21	**Part – III: Allied – 2:** Mathematical Foundations – II	4	3	25	75	100	4
6.	23UCDS21	**Part – IV: SBS – 2:** **Lab – IV:** Linux and Shell Programming	2	3	40	60	100	2
7.	21UACES1	**Part – IV:** Environmental Studies	2	3	25	75	100	2
	Total		**30**					**22**

SOURASHTRA COLLEGE, MADURAI - 625004

(An Autonomous Institution Re-accredited with 'B+' grade by NAAC)

B.Sc. COMPUTER SCIENCE (CLOUD COMPUTING AND CYBER SECURITY) - SYLLABUS

(Under CBCS based on OBE) (with effect from 2023 - 2024)

COURSE STRUCTURE - I SEMESTER

S No	CODE	Subject	Hrs./ Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1.	21UACT11	**Part – I: Tamil** – ftijAk rpWfijAk;	6	3	25	75	100	3
	21UACH11	**Hindi** – Hindi – I						
	21UACS11	**Sanskrit** – Sanskrit – I						
2.	21UACE11	**Part – II: English** – English For Enrichment – I	6	3	25	75	100	3
3.	23UCDC11	**Part – III: Core – 1:** Programming in C	4	3	25	75	100	4
4.	23UCDCP1	**Part – III: Core – 2: Lab – I**: Programming in C	6	3	40	60	100	4
5.	23UCDA11	**Part – III: Allied – 1:** Mathematical Foundations – I	4	3	25	75	100	4
6.	23UCDS11	**Part – IV: SBS – 1: Lab– II:** PC Assembling, Trouble Shooting and System Management	2	3	40	60	100	2
7.	21UACVE1	**Part – IV:** Value Education	2	3	25	75	100	2
	Total		**30**				**700**	**22**

CA – Class Assessment (Internal)

SE – Summative Examination

SBS – Skill Based Subject

T – Theory

P – Practical

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
23UCDC11	PROGRAMMING IN C	CORE – 1	4	–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability	✓	Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course provides the fundamental knowledge of a programming language and its features which enhances the user to write general purpose application programs.

COURSE OBJECTIVES:

- To introduce and form a firm foundation in programming
- To stress the importance of clarity, simplicity and the efficiency in writing programs

COURSE OUTCOMES (COs):

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

No.	Course Outcome	Knowledge Level (According to Bloom's Taxonomy)
CO1	identify the basic concepts needed for program development	Upto K3
CO2	apply the basic concepts and develop program to find solutions for simple problems	Upto K3
CO3	design programs to solve complex problems by using suitable control statements	Upto K3
CO4	analyze the problem and design efficient program using functions	Upto K3
CO5	use array and structure to handle volume of data	Upto K3

K1 – KNOWLEDGE (REMEMBERING), K2– UNDERSTANDING, K3– APPLICATION

PROGRAMMING IN C

UNIT – I:

Overview of C: History of C – Importance of C – Basic Structure of C Programs– Programming Style – Character Set – C Tokens – Keywords and Identifiers – Constants, Variables and Data Types – Declaration of Variables – Defining Symbolic Constants – Declaring a variable as a constant – overflow and underflow of data.

Operators and Expressions: Arithmetic, relational, logical, assignment operators – increment and decrement operators, conditional operators, bitwise operators, special operators – **Arithmetic Expressions**– Evaluation of Expressions – Precedence of Arithmetic Operators – Type Conversions in Expressions – Operator Precedence and Associativity – Mathematical functions.

UNIT – II:

Managing I/O Operations: Reading and Writing a Character – Formatted Input, Output – Decision Making & Branching: if statement – if else statement – nesting of if else statements – else if ladder – switch statement – the ?: operator – goto statement – the while statement – do statement – the for statement – jumps in loops. **UNIT – III:**

Arrays: One– Dimensional Arrays – Declaration, Initialization – Two– Dimensional Arrays – Multi– dimensional Arrays – Dynamic Arrays Initialization.

Strings: Declaration, Initialization of string variables – reading and writing strings – string handling functions.

UNIT – IV:

User– defined functions: Need – multi– function programs – elements of user defined functions – definition – return values and their types – function calls, declaration, category – all types of arguments and return values – nesting of functions – recursion – passing arrays, strings to functions – scope visibility and life time of variables. **Structures and Unions:** Defining a structure – declaring a structure variable – accessing structure members – initialization – copying and comparing – operation on individual members – array of structures – arrays within structures – structures within structures – structures and functions –unions– size of structures – bit fields. **UNIT – V:**

Pointers : Understanding Pointers, Accessing the address of a variable – declaring, initialization of pointer variables – accessing a variable through its pointer – chain of pointers– pointer increments and scale factors – pointers and character strings – pointers as function arguments – pointers and structures. **Files:** Defining, opening, closing a file – IO Operations on files – Error handling during IO operations – command line arguments.

TEXT BOOKS:

1. ***Programming in ANSI C***, E. Balagurusamy, 7th Edition, Tata Mc Graw Hill Publishing Company, 2017.

REFERENCE BOOKS:

1. ***Programming with C***, Schaum,,s Outline Series, Gottfried,Tata McGraw Hill, 2006.
2. ***Programming with ANSI and Turbo C***, Ashok N. Kamthane , Pearson Education, 2006.

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	–	–	–	–	–
CO2	–	2	1	–	–	2
CO3	2	–	–	–	–	–
CO4	2	–	2	3	–	1
CO5	2	2	2	3	2	1

3. Advanced Application 2. Intermediate Development 1. Introductory Level

SOURASHTRA COLLEGE, MADURAI - 625004

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B.Sc. COMPUTER SCIENCE (CLOUD COMPUTING AND CYBER SECURITY) - SYLLABUS

(Under CBCS based on OBE) (with effect from 2023 - 2024)

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
23UCDCP1	LAB: PROGRAMMING IN C	CORE – 2 LAB – I	–	6	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	40	60	100

NATURE OF COURSE	Employability	✓	Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course is designed to develop logic and programming skills through immersion in the fundamentals of C which enhances the user to write general purpose application programs in C.

COURSE OBJECTIVES:

- To develop logics which will help them to create programs, applications in C.
- To enhance the analyzing and problem solving skills and use the same for writing programs in C.

COURSE OUTCOMES (COs):

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

No.	Course Outcome	Knowledge Level (According to Bloom's Taxonomy)
CO1	Understand basic Structure of the C-PROGRAMMING, declaration and usage of variables	Upto K3
CO2	Manage I/O operations in your C program	Upto K3
CO3	Control the sequence of the program and give logical outputs	Upto K3
CO4	Apply code reusability with functions and pointers	Upto K3
CO5	Understand the basics of file handling mechanisms	Upto K3

K1 – KNOWLEDGE (REMEMBERING), K2– UNDERSTANDING, K3– APPLICATION

LAB: PROGRAMMING IN C

Section A:

1. Write a C Program to find the sum of digit
2. Write a C Program to check whether a given number is Armstrong or not
3. Write a C Program to check whether a given number is Prime or not
4. Write a C Program to generate the Fibonacci series
5. Write a C Program to display the given number is Adam number or not
6. Write a C Program to print reverse of the given number and string
7. Write a C Program to find minimum and maximum of _n,, numbers using array
8. Write a C Program to arrange the given number in ascending order
9. Write a C Program to add, subtract and multiply two matrices
10. Write a C Program to calculate NCR and NPR

Section B:

11. Write a C Program to find the grade of a student using else if ladder
12. Write a C Program to implement the various string handling functions
13. Write a C Program to create an integer file and display the even numbers only
14. Write a C Program to calculate quadratic equation using switch– case
15. Write a C Program to implement the various string handling function
16. Write a C Program to generate student mark list using array of structures
17. Write a C Program to create and process the student mark list using file
18. Write a C Program to create and process pay bill using file
19. Write a C Program to create and process inventory control using file
20. Write a C Program to create and process electricity bill using file

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
23UCDA11	MATHEMATICAL FOUNDATIONS - I	ALLIED – 1	4	–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability	✓	Skill Oriented		Entrepreneurship	

COURSE DESCRIPTION:

This course provides the fundamental knowledge of Mathematical foundations like Logic, Relations, Counting, Graph Theory and Matrices.

COURSE OBJECTIVES:

- To impart knowledge on solving problems using Logic
- To give the basic ideas about Relation
- To teach the basic concepts of Counting
- To give the basic concepts of Graph Theory and its applications
- To solve various problems using Matrices

COURSE OUTCOMES (COs):

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

No.	Course Outcome	Knowledge Level (According to Bloom's Taxonomy)
CO1	discuss the idea of Proposition, Predicates and Quantifiers	Upto K3
CO2	identify the basic concepts of Relations	Upto K3
CO3	explain the basic concepts of Pigeonhole principle, Permutation, Combination and applications of Recurrence relations.	Upto K3
CO4	acquire knowledge about the basic concepts of Graph Theory and its applications	Upto K3
CO5	find Eigen values and Eigen vectors using matrix concept	Upto K3

K1 – KNOWLEDGE (REMEMBERING), K2– UNDERSTANDING, K3– APPLICATION

MATHEMATICAL FOUNDATIONS – I

UNIT – I: The Foundations: Logic and Proofs

Propositional logic – Applications of Propositional logic – Propositional equivalences – (Exclude Propositional satisfiability, Applications of satisfiability, Solving satisfiability problems, and its related problems) – Predicates and Quantifiers – Rules of inference. **UNIT – II: Relations**

Relations and their properties – Representing relations – Closures of relations – Partial orderings (Theorems statement only; Exclude lexicographic ordering – Exclude Lattices) **UNIT – III: Counting**

The basic of counting – The pigeonhole principle – Permutation and Combinations – Applications of recurrence relations – Solving recurrence relations – Divide and Conquer algorithms and recurrence relations. (All theorems and Results statement only) **UNIT – IV: Graphs**

Graphs and Graphs models, (Excluding Biological networks; Tournaments; all its related examples and problems) – Graph terminology and special types of graphs – Representing graphs and Graph isomorphism – Connectivity (paths – connectedness in undirected graphs – paths and isomorphism – counting paths between vertices) – shortest path problems. **UNIT – V: Matrices**

Introduction – operations – inverse – Rank of a matrix, solution of simultaneous linear equations – Eigen values and Eigen Vectors.

TEXT BOOKS:

1. ***Discrete Mathematics and its Applications***, Seventh Edition, Kenneth. H. Rosen, Mc Graw Hill Publishing Company,2012.
2. ***Discrete Mathematics***, M. Venkataraman, N. Sridharan and N. Chandrasekaran, The National Publishing Company,2009.

REFERENCE BOOKS:

1. ***Modern Algebra*** – S.Arumugam and A. Thangapandi Isaac, SciTech publications, 2005.
2. ***Invitation to Graph Theory*** – S.Arumugam and S.Ramachandran, Scitech Publications, 2005, Chennai.
3. ***Discrete Mathematical Structures with applications to Computer Science*** – Tremblay and Manohar, McGrawHill, 1997.
4. ***Mathematical Structure for Compute Science, Discrete Mathematics and its Applications***, Judith L.Gersting, W.H.Freeman and Company, Seventh Edition, 2014.

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	–	–	3	2	–	3
CO2	–	–	3	2	–	3
CO3	–	–	3	2	–	3
CO4	–	–	3	2	–	3
CO5	–	–	3	2	–	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
23UCDS11	LAB: PC ASSEMBLING, TROUBLE SHOOTING AND SYSTEM MANAGEMENT	SBS – 1 LAB – II	–	2	2

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	40	60	100

NATURE OF COURSE	Employability	✓	Skill Oriented	✓	Entrepreneurship	✓

COURSE DESCRIPTION:

This course provides the fundamental knowledge of component identification, memory-system, peripheral installation and configuration, preventive maintenance, hardware repair/Troubleshooting, installation/format Operating system and system configuration, and device-drivers.

COURSE OBJECTIVES:

- It aims to Understand basic concept & structure of Computer Hardware & Networking Components.
- To Apply their knowledge about computer peripherals to identify/rectify problems on board.

COURSE OUTCOMES (COs):

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

No.	Course Outcome	Knowledge Level (According to Bloom's Taxonomy)
CO1	A hands-on approach will be used to provide the student with a basic skill level to work on a computer with the lid off	Upto K3
CO2	Student will be able to understand the hardware specifications that are required to run operating system and various shipboard application programs.	Upto K3
CO3	Perform routine maintenance, upgrades	Upto K3
CO4	Manage data backup & restore operations on server and update anti-virus software and set schedules	Upto K3
CO5	Learn basic networking hardware and tools	Upto K3

K1 – KNOWLEDGE (REMEMBERING), K2– UNDERSTANDING, K3– APPLICATION

LAB: PC ASSEMBLING, TROUBLESHOOTING AND SYSTEM MANAGEMENT

PC Assembling

Installing the motherboard.
Installing the CPU and heat sink.
Installing the RAM.
Installing the power supply.
Installing the hard disk and optical drive.
Connecting various cables (ATX power connector, cabinet cables for power, reset button, front USB/audio panel cable).
BIOS settings – setting time, changing boot sequence, system password setting
Changing CMOS battery
Connecting extra cabinet fan

PC Troubleshooting

Booting with CD/DVD, pen drive, LAN & hard disk with different OS
Formatting hard drive.
Installing the OS and drivers.
Troubleshooting BSOD (blue screen of death)
Installation of service packs, applications such as MS Office, Anti– virus software.
Creating restore point and backup a drive.
Using hard disk tools (sfc, disk checker, defragmenter, data recovery).
Windows update, registry fix, msconfig, gpedit.
Using repair tools like ccleaner, system mechanic, malware bytes.

System Management

Familiarization with configuring and installing a LAN (Assign IP addresses)
Internet connection sharing over LAN
File transfer over LAN
Installing and using web browser and firewall
Using search engines like Google
CD/DVD burning – image burning – date/audio/video CD/DVD making with Nero
Playing audio and video with VLC media player – creating play list.

REFERENCE BOOKS:

1. Mueller, Scott, ***Upgrading & Repairing PCs***, 14th Edition, Que Publishing, 2003. Moulton, Pete, "A+ Certification and PC repair Guide", 2nd Edition, Prentice Hall PTR, 2002.
2. Loukides, Mike, Musumeci, G., ***System Performance Tuning***, 2nd Edition, O"Reilly, 2002.
3. Bigelow, Stephen, ***Troubleshooting, Maintaining & Repairing PCs***, 5th Edition, Osborne, 2002.

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B.Sc. COMPUTER SCIENCE (CLOUD COMPUTING AND CYBER SECURITY) - SYLLABUS

(Under CBCS based on OBE) (with effect from 2023 - 2024)

COURSE STRUCTURE - II SEMESTER

S No	CODE	Subject	Hrs./ Week	Exam (Hrs.)	CA	SE	Total Marks	Credits
1.	21UACT21	**Part – I: Tamil** – nra;ASk; GjpdKk;	6	3	25	75	100	3
	21UACH21	**Hindi** – Hindi – II						
	21UACS21	**Sanskrit** – Sanskrit – II						
2.	21UACE21	**Part – II: English** – English For Enrichment – II	6	3	25	75	100	3
3.	23UCDC21	**Part – III: Core – 3:** Java Programming	4	3	25	75	100	4
4.	23UCDCP2	**Part – III: Core – 4: Lab – III**: Java Programming	6	3	40	60	100	4
5.	23UCDA21	**Part – III: Allied – 2:** Mathematical Foundations – II	4	3	25	75	100	4
6.	23UCDS21	**Part – IV: SBS – 2: Lab – IV:** Linux and Shell Programming	2	3	40	60	100	2
7.	21UACES1	**Part – IV:** Environmental Studies	2	3	25	75	100	2
	Total		**30**					**22**

CA – Class Assessment (Internal)

SE – Summative Examination

SBS – Skill Based Subject

T – Theory

P – Practical

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
23UCDC21	JAVA PROGRAMMING	CORE – 3	4	–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship
	✓	✓	

COURSE DESCRIPTION:

This course teaches students the syntax of the Java programming language; object-oriented programming with the Java programming language; creating graphical user interfaces (GUI), exceptions, and file input/output (I/O).

COURSE OBJECTIVES:

- To understand the basic concepts and fundamentals of platform independent object oriented language.
- To demonstrate skills in writing programs using exception handling techniques and multithreading.
- To understand streams and efficient user interface design techniques.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	understand the basic concepts of Object oriented programming and java evolution and features	Upto K3
CO 2	apply the basic concepts of OOP, java features and its applications.	Upto K3
CO 3	write object oriented programs using Inheritance, Strings and Vectors, Interfaces.	Upto K3
CO 4	design object oriented programs, multithreading, exception handling,	Upto K3
CO 5	understand Packages and Data files in JAVA.	Upto K3

K1 – KNOWLEDGE (REMEMBERING), K2 – UNDERSTANDING, K3 – APPLY

JAVA PROGRAMMING

UNIT – I: Fundamentals of Object – Oriented Programming

Introduction, Object Oriented paradigm, Basic Concepts of OOP, Benefits of OOP, Applications of OOP, Java features.

Overview of Java Language: Introduction, Simple Java program structure, Java tokens, Java Statements, Implementing a Java Program, Java Virtual Machine, Command line arguments.

Constants, Variables & Data Types: Introduction, Constants, Variables, Data Types, Declaration of Variables, Giving Value to Variables, Scope of variables, Symbolic Constants, Type casting, Getting Value of Variables, Standard Default values; Operators & Expressions.

UNIT – II: Decision Making & Branching:

Introduction, Decision making with if statement, Simple if statement, if. Else statement, Nesting of if. else statements, the else if ladder, the switch statement, the conditional operator.

Decision Making & Looping: Introduction, The While statement, the do– while statement, the for statement, Jumps in loops.

Classes, Objects & Methods: Introduction, Defining a class, Adding variables, Adding methods, Creating objects, Accessing class members, Constructors, Method overloading, Static members, Nesting of methods;

UNIT – III: Inheritance:

Extending a class, Overloading methods, Final variables and methods, Final classes, Finalizer methods, Abstract methods and classes;

Arrays, Strings and Vectors: Arrays, One– dimensional arrays, Creating an array, Two– dimensional arrays, Strings, Vectors, Wrapper classes

Interfaces: Multiple Inheritance: Introduction, Defining interfaces, Extending interfaces, Implementing interfaces, Assessing interface variables; **UNIT – IV: Multithreaded Programming:**

Introduction, Creating Threads, Extending the Threads, Stopping and Blocking a Thread, Lifecycle of a Thread, Using Thread Methods, Thread Exceptions, Thread Priority, Synchronization, Implementing the „Runnable" Interface.

Managing Errors and Exceptions: Types of errors: Compile– time errors, Runtime errors, Exceptions, Exception handling, Multiple Catch Statements, Using finally statement.

UNIT – V: Packages:

Introduction, Java API Packages, Using System Packages, Naming conventions, Creating Packages, Accessing a Package, using a Package.

Managing Input/ Output Files in Java: Introduction, Concept of Streams, Stream classes, Byte Stream Classes, Input Stream Classes, Output Stream Classes, Character Stream classes: Reader stream classes, Writer Stream classes, Using Streams, Reading and writing files.

TEXT BOOKS:

Programming with JAVA, A Primer, E. Balagurusamy, 5th Edition, McGraw– Hill Company, 2015.

Unit I : Chapters 1 – 5
Unit II : Chapters 6,7 and 8.1– 8.10
Unit III : Chapter 8.11– 8.18, Chapters 9 and 10
Unit IV : Chapter 12 and 13
Unit V : Chapter 14, 11.1– 11.7 and 16

REFERENCE BOOKS:

1. ***Introduction to JAVA Programming***, K. Somasundaram, Jaico Publishing House, New Delhi, 2013.
2. K. Somasundaram, ***Don Learn JAVA – A Practical Approach***, Anuradha Publications, Chennai,2013.
3. ***Programming in Java***, Sachin Malhotra, Oxford University Press
4. ***Programming with Java***: ***Based on Schaums's Outline of Programming with Java,*** Tata John R. Hubbard, Second Edition, McGraw – Hill Company,2001.

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3					
CO2		2	1			2
CO3	2					
CO4	2		2	3		1
CO5	2	2	2	3	2	1

3. Advanced Application 2. Intermediate Development 1. Introductory Level

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B.Sc. COMPUTER SCIENCE (CLOUD COMPUTING AND CYBER SECURITY) - SYLLABUS

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20

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
23UCDCP2	LAB: JAVA PROGRAMMING	CORE – 4 LAB – III	–	6	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	40	60	100

NATURE OF COURSE	Employability	✓	Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course provides the object oriented programming features which supports modular programming and Applet programming features which support web based programming.

COURSE OBJECTIVES:

- To introduce Object oriented programming and Applet programming concepts using JAVA and improve their OOP and Applet programming Skills.
- To introduce Object oriented programming and java programming features– Encapsulation, Polymorphism, Inheritance, Multithreading, Exception handling, Interface, Package and Applets and Graphics.
- To develop programs for data file access using JAVA streams classes.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	write programs using Object oriented programming paradigm – Encapsulation (Classes and objects), Polymorphism and Inheritance.	Upto K3
CO 2	apply various java features like multithreading, exceptional handling, interface, package, overloading, overriding	Upto K3
CO 3	utilize different types of inheritance to suit different applications	Upto K3
CO 4	design to write programs using Object oriented programming paradigm that enables runtime polymorphism using interface and applet programming	Upto K3
CO 5	apply Object oriented programming paradigm for flat file organization. – Sequential and Random access	Upto K3

K1 – KNOWLEDGE (REMEMBERING), K2 – UNDERSTANDING, K3 – APPLY

LAB: JAVA PROGRAMMING

Write Programs in Java for the following:

1. To implement a simple temperature conversion program.
2. To perform addition and subtraction of complex numbers using class and objects.
3. To perform volume calculation using method overloading.
4. Using command line arguments, test if the given string is palindrome or not.
5. String manipulation using String Methods (Use of any five String methods are preferred).
6. Write a program to fill names into a list. Also, copy them in reverse order into another list. If the name contains any numeric value throw an exception Invalid Name
7. Program to demonstrate the use of any two built– in exceptions in Java.
8. To perform multiplication of matrices using class and objects.
9. Using multilevel inheritance process student marks.
10. Implement multiple inheritance for payroll processing.
11. Implement interface for area calculation for different shapes.
12. Create a package called Arithmetic that contains methods to deal with all arithmetic operators. Also write a program to use the package
13. Create two threads such that one of the threads generate Fibonacci series and another generate perfect numbers between two given limits.
14. Define an exception called**:** Marks Out of bound: Exception, that is thrown if the entered marks are greater than 100.
15. Program to demonstrate the use of Wrapper class methods.
16. File Processing using Byte stream.
17. File Processing using Character Stream.
18. Write applets to draw the following Shapes:
    (a). Cone **(b).** Cylinder **(c).** Square inside a Circle **(d).** Circle inside a Square
19. Write an applet Program to design a simple calculator.
20. Write an Applet Program to animate a ball across the Screen.

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
23UCDA21	MATHEMATICAL FOUNDATIONS – II	ALLIED – 2	4	–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability	✓	Skill Oriented		Entrepreneurship	

COURSE DESCRIPTION:

This course helps to provide the fundamental knowledge of Mathematical foundations based on Statistics and Probability.

COURSE OBJECTIVES:

- To impart knowledge on data collection and diagrammatic representation in Statistics
- To give the basic ideas about Moments and Skewness
- To teach the basic concepts of Correlation and Regression
- To give the basic concepts of Probability
- To solve various problems using t– test, F– test and Chi– square test.

COURSE OUTCOMES (COs):

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

No.	Course Outcome	Knowledge Level (According to Bloom's Taxonomy)
CO1	define collection of data and state the representation of data in Bar – charts, Pie – diagrams, Histograms, Frequency polygon and Ogives.	Upto K3
CO2	explain the concept of moments, skewness and kurtosis solve problems	Upto K3
CO3	define correlation, regression and solve problems in correlation, rank correlation. Also find the regression equations.	Upto K3
CO4	explain addition, multiplication theorem, conditional probability, independent events, expectation and solve problems	Upto K3
CO5	solve problems in t– test, F– test and chi– square test	Upto K3

K1 – KNOWLEDGE (REMEMBERING), K2 – UNDERSTANDING, K3 – APPLY

MATHEMATICAL FOUNDATIONS – II

UNIT – I: Introduction to Statistics:

Primary and secondary data–classification, tabulation and Diagrammatic Representation of statistical data – Bar– charts, Pie– diagrams‟‟ – Graphical Representation of data – Histograms, Frequency polygon, Ogives.

UNIT – II: Measures of Dispersion:

Characteristics–coefficient of dispersion – Coefficient of variation–Moments – skewness and kurtosis – Pearson‟‟s coefficient of skewness – Bowley‟‟s coefficient of Skewness – Coefficient of skewness based upon moments.

UNIT – III: Simple Correlation:

Karl Pearson‟‟s coefficient of correlation –correlation coefficient for A bivariate frequency distribution – Rank correlation – Regression – lines of regression – Properties of regression coefficient.

UNIT – IV: Events and Sets:

Sample space – concept of probability–addition and multiplications Theorem on probability – conditional probability and independence of evens – Baye‟‟s Theorem – concept of random variable – Mathematical Expectation.

UNIT – V: Concept of Sampling Distributions:

standard error–Tests of significance based on t, Chi – square and F distributions with respect to mean, variance.

TEXT BOOKS:

Statistical Methods, S.P. Gupta, Sultan Chand and sons, 2004.
Unit I : Chapters 1, 2.2, 2.2.1, 2.2.2, 2.2.3 – 2.2.5
Unit II : Chapters 7 and 8
Unit III: Chapters 9, 9.1, 9.2, 9.3, 10, 10.1, 10.2, 10.2.1, 10.2.2, 10.2.3, 10.3
Unit IV: Chapter 16
Unit V : Chapters 18.3, 18.4, 18.7.1, 18.7.2, 19

REFERENCE BOOKS:

1. Statistics, Dr. S. Arumugam and A. Thangapandi Issac, New Gamma Publication house, 2002.
2. Kishor S. Trivedi – Probability and statistics with reliability queuing and Computer Science
3. Applications – Prentice Hall of India (P) Ltd., New Delhi – 1997. Discrete Mathematics – Seymour Lipschutz, Marc Lars Lipson Schaum‟‟s Outlines– by, 3rd Edition., Tata McGraw Hill, Education Pvt. Ltd., New Delhi. 5th Reprint 2012.

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	3	3	–	3
CO2	–	1	3	2	–	3
CO3	–	1	3	2	–	3
CO4	1	2	3	2	–	3
CO5	2	3	3	2	–	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
23UCDS21	LAB: LINUX AND SHELL PROGRAMMING	SBS – 2 LAB – IV	–	2	2

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	40	60	100

NATURE OF COURSE	Employability	✓	Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

To understand the basic principles of Linux OS and also help them understand its utilities.

COURSE OBJECTIVES:

To understand and make effective use of **Linux** utilities and shell scripting language to solve problems.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO1	write simple programs using basic commands	**Upto K3**
CO2	write simple programs using mathematical logic	**Upto K3**
CO3	write a simple programs using strings	**Upto K3**
CO4	write a simple programs using while loop	**Upto K3**
CO5	write a simple programs using files	**Upto K3**

K1 – KNOWLEDGE (REMEMBERING), K2 – UNDERSTANDING, K3 – APPLY

LAB: LINUX AND SHELL PROGRAMMING

SECTION – A

1. Write a Linux script to find the number of users who have logged in.
2. Write a Linux script to see the current date, user name and current directory.
3. Write a Linux script to print the numbers 5,4,3,2,1 using While loop.
4. Write a Linux script to set the attributes of a file.
5. Write a Linux script to convert lowercase to uppercase using trutility.
6. Write a Linux script to copy and rename a file.
7. Write a Linux script to add 5 numbers and find the average.
8. Write a Linux script to convert a decimal number to hexadecimal conversion.
9. Write a Linux script to find the factorial of a number.
10. Write a Linux script to check for palindrome.

SECTION – B

11. Write a Linux script to display Hello World in Bold, Blink effect and in different colors like red, green etc.
12. Write a Linux script to display a multiplication table.
13. Write a Linux script to perform arithmetic operations using case.
14. Write a Linux script to add two real numbers.
15. Write a Linux script to display the following pattern:
    1
    22
    333
    4444
    55555
16. Write a Linux script to find the sum of digits and reversing of a given number.
17. Write a Linux script to display the student mark details.
18. Write a Linux script to prepare electricity bill.
19. Write a Linux script to sort the numbers in ascending order.
20. Write a Linux script
    (i) To create and append a file
    (ii) To compare two files.

ABOUT THE DEPARTMENT

The Department of Microbiology was established in the year 1994 with UG course. The Post Graduate Microbiology course was started in the year 2000. The Department has produced 29 UG batches and 16 PG batches. Ever since its inception, the Department has been constantly concentrating to stay updated with the latest developments. The Department has well equipped laboratory and library to cater the requirements of the syllabi. All the graduates and postgraduates of the Department have been well placed in the various fields of Microbiology. The Postgraduate Department has 6 faculty members who are eminent scholars and have wide knowledge in the field.

VISION

To be a focal point of brilliance in higher education that emphasizes pioneeringeducation, knowledge on research and development in the field of microbiology.

MISSION

- To afford eminent edification in microbiology programmed to enrich the academic foundation and preparation of students for life in an intricate dynamic technological world.
- To generate and propagate awareness through interdisciplinary research in thefield of Microbiology

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Microbiology Postgraduates of the Sourashtra College will: The Programme Educational Objectives of the **M.Sc. in Microbiology** Programme at Sourashtra College, Madurai are given below and are numbered from PEO1 to PEO5.

PEO 1	To provide in – depth knowledge about core areas of biosciences such as biotechnology, biochemistry and microbiology.
PEO 2	To make students competent in the field of biosciences and allied areas byproviding them hands on experience in basic tools and techniques
PEO 3	To instill the ability for research and entrepreneurship in the students alongwith strong ethics and communication skills.
PEO 4	To inculcate, facilitate, motivate and promote knowledge technical skills in core areas of biological sciences including advanced tools and techniques like genomics, proteomics and transcriptomics to young aspirants and to equip and motivate the students to pursue higher education and research in reputed institutes at national and international level in the field Science
PEO 5	To develop trained human resource in the field of advanced translational research and to develop graduates with a strong professional ethics and moral duties that will positively affect their profession, community, society and Nation at large.

POSTGRADUATE (PG) PROGRAMME OUTCOMES (POs)

Postgraduate (M.A., **M.Sc.,** M.Com., M. Com (CA)., M.B.A., M.C.A., etc.,) is a two year degree Programme with 4 semesters consisting the following Programme Outcomes (POs) under various criteria including critical thinking, problem solving, effective communication, societal/ citizenship/ ethical credibility, sustainable growth and employable abilities.

PO 1	**Critical Thinking**: Intellectual exploration of knowledge towards actions in clear and rational manner by understanding the logical connections between ideas and decisions.
PO 2	**Problem Solving**: Understanding the task/ problem followed by planning andnarrow execution strategy that effectively provides the solution.
PO 3	**Effective Communication**: Knowledge dissemination by oral and verbal mechanisms to the various components of our society.
PO 4	**Societal/ Citizenship/ Ethical Credibility**: Realization of various value systems/ moral dimensions and demonstrate the empathetic social concern as well as equity in all the decisions, executions and actions.
PO 5	**Environmental Concern and Sustainable Growth**: Understanding the emerging environmental challenges and provide the possible contribution in sustainable development that integrates environment, economy and employment.
PO 6	**Skill Development and Employable Abilities**: Adequate training in relevantskill sector and creating employable abilities among the PG.

PROGRAMME SPECIFIC OUTCOMES (PSOs)
MICROBIOLOGY PROGRAMME

PSO 1	**Placement** Prepare the students in varied disciplines like agriculture, industry – medical, pharma, dairy, hotel, food and food processing, immunological, cosmetics, vermitechnology and water treatment for effective and respectful placement.
PSO 2	**Entrepreneurship** To create effective entrepreneur by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups andhigh potential organizations.
PSO 3	**Research and Development** Design and implement HR systems that comply with good laboratory, practices, following ethical values, leading the organization towards growth anddevelopment.
PSO 4	**Contribution to Society** To contribute to the development of society and produce microbiological products, by collaborating with stake holders, related to the betterment of environment and mankind at the national and global level.

DISTRIBUTION OF CREDITS (PG PROGRAMME)

PART	SEMESTER	COURSES	NUMBER OF COURSES	HOURS	CREDITS	TOTAL CREDITS
I	I – II	CORE	10	5 – 6	4 – 5	40
I	III – IV	CORE	8	5 – 6	4 – 5	32
II	I – II	ELECTIVE	2	5 – 6	3 – 5	6
II	IV	ELECTIVE	1	5 – 6	3 – 5	3
IV	II&III	EXTENSION ACTIVITY	1	–	1	1
III	III	NON MAJOR ELECTIVE (NME)	1	6	5	5
III	IV	PROJECT	1	18	4 – 5	5
	III	INTERNSHIP	1		1	1
TOTAL CREDITS						93

Extra credits may be earned through SWAYAM Courses/other online courses

SOURASHTRA COLLEGE, MADURAI– 625004

(An Autonomous Institution Re-accredited with 'B+' grade by NAAC)

M.Sc. MICROBIOLOGY – SYLLABUS

(Under CBCS based on OBE)(For those admitted during 2024 – 2025 and after)

M.Sc. MICROBIOLOGY – I YEAR

COURSE STRUCTURE – I SEMESTER

S. No.	Course Code	Course Title	Hrs./ Week	Exam (Hrs.)	CA	SE	Total	Credits
1.	24PMBC11	**Core – 1:** General Microbiology and Microbial Physiology	5	3	25	75	100	4
2.	24PMBC12	**Core – 2:** Molecular Biology and Microbial Genetics	5	3	25	75	100	4
3.	24PMBC13	**Core – 3:** Bioprocess Technology	4	3	25	75	100	4
4.	24PMBCP1	**Core – 4: Core Practical – I:** Lab in General Microbiology	6	3	40	60	100	4
5.	24PMBCP2	**Core – 5: Core Practical – II:** Lab in Molecular Biology and Microbial Genetics	6	3	40	60	100	4
6.	24PMBE11	**Elective – 1: *** Microbial Biochemistry	4	3	25	75	100	3
	24PMBE12	Biophysics and Bioinstrumentation						
	24PMBE13	Nano Biotechnology						
		TOTAL	**30**					**23**

***One elective course to be chosen from THREE courses**

II – SEMESTER

S. No	Course Code	Course Title	Hrs./ Week	Exam (Hrs.)	CA	SE	Total	Credits
1.	24PMBC21	**Core – 6:** Genetic Engineering	5	3	25	75	100	4
2.	24PMBC22	**Core – 7:** Immunology	4	3	25	75	100	4
3.	24PMBC23	**Core – 8:** Bioinformatics and Microbial Omics	5	3	25	75	100	4
4.	24PMBCP3	**Core – 9: Core Practical – III:** Lab in Immunology	6	3	40	60	100	4
5.	24PMBCP4	**Core – 10: Core Practical – IV:** Lab in Genetic Engineering and Bioinformatics	6	3	40	60	100	4
6.	24PMBE21	**Elective – 2: *** Microbial Ecology and Toxicology	4	3	25	75	100	3
	24PMBE22	Biomass and Bioenergy						
	24PMBE23	Medical Virology and Parasitology						
7.		Internship	–	–	–	–	–	–
		TOTAL	**30**					**23**

***One elective course to be chosen from THREE courses**

III – SEMESTER

S. No.	Course Code	Course Title	Hrs./ Week	Exam (Hrs.)	CA	SE	Total	Credits
1.		**Core – 11:**Medical Microbiology and Epidemiology	5	3	25	75	100	4
2.		**Core – 12:**Food and Agricultural Microbiology	4	3	25	75	100	4
3.		**Core – 13:** Environmental Microbiology& Aquatic Microbiology	4	3	25	75	100	4
4.		**Core – 14: Core Practical – V:** Lab in Clinical Microbiology	6	6	40	60	100	4
5.		**Core – 15: Core Practical – VI:** Lab in Applied Microbiology	6	6	40	60	100	4
6.		**NME**	5	6	25	75	100	5
7.		**Internship**	–	–	40	60	–	1
		TOTAL	**30**					**26**

IV – SEMESTER

S. No.	Course Code	Course Title	Hrs./ Week	Exam (Hrs.)	CA	SE	Total	Credits
1.		**Core – 16: R**esearch Methodology and Biostatistics.	5	3	25	75	100	4
2.		**Core – 17:** Forensic Science	5	3	25	75	100	4
3.		**Core – 18**: Herbal Technology and Cosmetic Microbiology	5	3	25	75	100	4
4.		**Elective–3:**	5	3	25	75	100	3
		Bio – entrepreneurship						
		Biosafety, Bioethics and IPR						
		Pharmaceutical Technology						
5.		Project with Viva Voce	10	–	–	–	–	5
		TOTAL	30					20

COURSE STRUCTURE – I SEMESTER

S. No.	Course Code	Course Title	Hrs./ Week	Exam (Hrs.)	CA	SE	Total	Credits
1.	24PMBC11	**Core – 1:** General Microbiology and Microbial Physiology	5	3	25	75	100	4
2.	24PMBC12	**Core – 2:** Molecular Biology and Microbial Genetics	5	3	25	75	100	4
3.	24PMBC13	**Core – 3:** Bioprocess Technology	4	3	25	75	100	4
4.	24PMBCP1	**Core – 4:** **Core Practical – I:** Lab in General Microbiology	6	3	40	60	100	4
5.	24PMBCP2	**Core – 5:** **Core Practical – II:** Lab in Molecular Biology and Microbial Genetics	6	3	40	60	100	4
6.	24PMBE11	**Elective – 1: *** Microbial Biochemistry	4	3	25	75	100	3
	24PMBE12	Biophysics and Bioinstrumentation						
	24PMBE13	Nano Biotechnology						
		TOTAL	**30**					**23**

***One elective course to be chosen from THREE courses**

CA – Class Assessment (Internal)

SE – Summative Examination

T – Theory

P – Practical

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBC11	GENERAL MICROBIOLOGY ANDMICROBIAL PHYSIOLOGY	CORE – 1	5	–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability		Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course is designed to introduce field of microbiology with special emphasis on microbial diversity, morphology, growth and nutrition; methods for control of microbes and viruses. Student can understand about the fundamentals of microbiology.

COURSE OBJECTIVES:

- Acquire knowledge on the principles of different types of microscopes and theirapplications.
- Illustrate about the taxonomic classification of bacteria, virus and fungi.
- Discuss the importance and conservation of microbial diversity.
- To enrich knowledge about the bacterial nutrition and their utilization.
- Discuss the metabolic pathways and photosynthesis process.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Evaluate the basics concepts of microbiology and different types of microscopy.	Upto K5
CO 2	To explain the taxonomy of microbes and their classification.	Upto K5
CO 3	Discuss the microbial diversity of microorganisms.	Upto K5
CO 4	Apply knowledge about nutritional requirement and microbial growth of an organism.	Upto K5
CO 5	Compare various metabolic pathways and discuss the properties and functions of enzyme.	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

GENERAL MICROBIOLOGY AND MICROBIAL PHYSIOLOGY

UNIT – I:

Historical developments of Microbiology – Contributors of Microbiology – Microscopy – Principles – types – Bright field, Dark – field, Phase – contrast, Fluorescence microscope, Transmission electron microscope (TEM) and Scanning electron microscope (SEM). Structure of prokaryotic and eukaryotic cell, Differences between Eubacteria, Archaebacteria and Eukaryotes.

UNIT – II:

Microbial Taxonomy – Classification – Binomial and numerical, phylogenetic tree, Haeckel's three kingdom, Whittaker's five kingdom; classification of bacteria – Bergey's classification; molecular taxonomy – polyphasic taxonomy and species concept. Classification of viruses – Baltimore system; classification of fungi by Alexopoulos and Mims.

UNIT – III:

Microbial diversity and extremophiles: distribution, ecological niche, abundance and density. Extremophiles – Psychrophiles, acidophiles, alkaliphiles,thermophiles, barophiles etc., non – culturable bacteria (Metagenomics). Methanogens, Methanotrophs and Methylotrophs.

UNIT – IV:

Microbial growth – Growth in batch culture, Mathematical representation of bacterial growth, Bacterial generation time, Specific growth rate, Monoauxic, Diauxic and synchronized growth curves, Measurement of microbial growth – Principles of microbial nutrition – Chemoautotrophs, chemoheterotrophs, photoautotrophs and photoheterotrophs.

UNIT – V:

Metabolic pathways in bacteria – Energy production in bacteria – energy and ATP, aerobic and anaerobic respiration, glycolysis, tricarboxylic acid cycle, electron transport and oxidative phosphorylation, phosphoketolase pathway, pentose phosphate pathway, gluconeogenesis and glyoxylate cycle. Photosynthetic bacteria and cyanobacteria – pigments of photosynthetic apparatus, mechanism of photosynthesis in bacteria – oxygenic and anoxygenic. Bacterial stress response – nutrient stress and starvation, thermalstress and the heat shock response, pH stress, and oxidative stress.

TEXT BOOKS:

1. Kanunga R. 2017. ***Ananthanarayanan and Panicker's Text book of Microbiology***. (10th Edition). Universities Press (India) Pvt. Ltd.
2. Chan E.C.S., Pelczar M. J. Jr. and Krieg N. R. 2010. ***Microbiology***. (5th Edition).Mc.Graw Hill. Inc, New York.
3. Prescott L. M., Harley J. P. and Klein D. A. 2004. ***Microbiology***. (6th Edition).McGraw – Hill company, New York.
4. White D. Drummond J. and Fuqua C. 2011. ***The Physiology and Biochemistry ofProkaryotes***, Oxford University Press, Oxford, New York.
5. Dubey R.C. and Maheshwari D. K. 2009. ***Textbook of Microbiology***. S. Chand,Limited

REFERENCE BOOKS:

1. Tortora G. J., Funke B. R. and Case C. L. 2015. ***Microbiology: An Introduction*** (12th Edition). Pearson, London, United Kingdom
2. Webster J. and Weber R.W.S. 2007. ***Introduction to Fungi***. (3rd Edition).Cambridge University Press, Cambridge
3. Schaechter M. and Lederberg J. 2004. ***The Desk encyclopedia of Microbiology***.Elsevier Academic Press, California.
4. Ingraham, J.L. and Ingraham, C.A. 2000. ***Introduction to Microbiology***. (2ndEdition). Books / Cole Thomson Learning, UK.
5. Madigan M. T., Bender K.S., Buckley D. H. Sattley W. M. and Stahl 2018. ***BrockBiology of Microorganisms***. (15th Edition). Pearson.

DIGITAL TOOLS:

1. http://sciencenetlinks.com/tools/microbeworld
2. https://www.microbes.info
3. https://www.asmscience.org/VisualLibrary
4. https://www.boundless.com/microbiology
5. www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBC12	MOLECULARBIOLOGY AND MICROBIAL GENETICS	CORE – 2	5	–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability		Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course has been designed to introduce the student to the advanced concepts in molecular biology and to become familiar with microbial gene transfer & to understand the biology of lytic and lysogenic phages

COURSE OBJECTIVES:

- Gain an in – depth knowledge of the structure of DNA, RNA and its types.
- Acquire knowledge in the mechanism of transcription and translation process.
- Understand the basis of genetic code and gene mapping.
- Gain knowledge about transduction process.
- To enlighten the molecular mechanism of transposons.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Illustrate the structure and function of DNA and RNA.	Upto K5
CO 2	Identify the transcription and translation mechanism and its process occur in prokaryotes.	Upto K5
CO 3	Give knowledge about mutation analysis and plasmids.	Upto K5
CO 4	Discuss the importance of gene transfer by conjugation methods and lytic, lysogeny cycle.	Upto K5
CO 5	To understand about the transposons and regulation of gene.	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

MOLECULAR BIOLOGY AND MICROBIAL GENETICS

UNIT – I:

Structure and forms of DNA. Properties of DNA, Structure and types of RNA. Replication of DNA – Types of replications. Mutability and repair of DNA; homologous recombination; site – specific recombination and transposition of DNA.

UNIT – II:

Mechanism of transcription – Initiation, Elongation and Termination. Transcription factors – activators and repressor. Gene regulation in development and evolution. Post – transcriptional Processes – processing of tRNA, rRNA and mRNA. Translational mechanism in prokaryotes.

UNIT – III:

Genetic nomenclature, wobble hypothesis. DNA damage and repair mechanism – Mutagenesis – causes and types. Genetic recombination – types, mapping and complementation analysis. Plasmids – Properties, types, replication, amplification and gene transfer. Mobile DNA – terminology, types,

UNIT – IV:

Molecular mechanism of gene transfer by conjugation. Conjugation – F and R factor. Gene Transfer by Transduction – specialized, generalized transduction and significance. Transformation – Natural transformation and competence – DNA uptake competence systems. Genetics of Phage T4 – Lytic and Lysogeny cycle.

UNIT – V:

Transposons – Classes of bacterial transposons, Molecular mechanisms of transposition, Regulation and effects of transposition in bacteria.. Gene regulation – Operon concept, co – ordinated control of structural genes. Positive and negative regulation in *E.coli*. Inducers and repressor.

TEXT BOOKS:

1. Abbas A. K., Lichtman A. H. and Pillai S. (2021). ***Cellular and MolecularImmunology***. (10th Edition). Elsevier.
2. Malacinski G.M. (2008). ***Freifelder's Essentials of Molecular Biology***.(4th Edition). Narosa Publishing House, New Delhi.
3. Gerald Karp (2014). Cell Biology (7th Edition). Wiley publishers.
4. Streips, U.N. & Yasbin, R.E., Modern Microbial Genetics edited (2nd Ed.). Wiley – Liss Publishers. 2002.
5. Freifelder. D., Stanley. R. (1994). ***Molecular Biology and Microbial Genetics.*** J and B Publications.

REFERENCE BOOKS:

1. Larry, S. Henkin. T.M., Peters. J.E. and Wendy. C (2012). ***Molecular Genetics ofBacteria*** (4th edition). ASM Press.
2. Glick B. R. and Patten C.L. (2018). ***Molecular Biotechnology*** – Principles andApplications of Recombinant DNA. (5th Edition). ASM Press.
3. Russell P.J. (2010). ***Genetics – A Molecular Approach***. (3rd Edition). Pearson NewInternational Edition.
4. Trun. N. & Trempy. J., ***Fundamentals of Bacterial Genetics.*** Wiley – BlackwellPublishing. 2004.
5. Lankenau DH, Volff JN, editors. 2009. ***Transposons and the Dynamic Genome.Genome Dynamics and Stability***. Springer Berlin Heidelberg.

DIGITAL TOOLS:

1. https://www.britannica.com/science/genetics
2. https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/General_Biology_1e_(OpenStax)/3%3A_Genetics/15%3A_Genes_and_Proteins/15.2%3A_Prokaryotic_Transcription
3. https://wou.edu/chemistry/courses/online – chemistry – textbooks/ch450 – and – ch451 – biochemistry – defining – life – at – the – molecular – level/chapter – 11 – translation/
4. https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/72/2120/et/Academic%20Script – MOD%201 – Microbial%20Genetics – MOOC20022405050202222.pdf
5. https://www.nature.com/scitable/topicpage/transposons – the – jumping – genes – 518/

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY		P	CREDITS
24PMBC13	BIOPROCESS TECHNOLOGY	CORE – 3		–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability		Skill Oriented	✓	Entrepreneurship	✓

COURSE DESCRIPTION:

This course introduces the basic concepts of Bioprocess Technology with a key emphasis on parts and functions of a bioreactor, types of bioreactors, the parameters involved in scaling up and scaling down, production and recovery of fermented products.

COURSE OBJECTIVES:

- To learn basics of bioprocess techniques, bioreactors, fermentation and media.
- Design and construct different type of bioreactors.
- To impart knowledge on operations of fermentation processes with all itsprerequisites
- To select appropriate bioreactor configurations and operation modes based uponthe nature of bioproducts and other process criteria
- Evaluate and monitoring with the help of computer knowledge.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Gain an understanding of an overview of fermentation and different types of fermentation process.	Upto K5
CO 2	Appreciate the fermenter design, types, workingprinciple and product formation in batch, continuous and fed – batch cultures.	Upto K5
CO 3	Able to determine the kinetics and different parameters involved in involved in bioreactors.	Upto K5
CO 4	Able to design the bioreactor, manipulate the microorganisms and uses the strains for producing industrially important products.	Upto K5
CO 5	Able to analyze the cost structures for designing the upstream and downstream process units.	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

BIOPROCESS TECHNOLOGY

UNIT – I:

Fermentation process – An overview, isolation, screening, preservation and improvement of industrially important microorganisms. Strain improvement for the selected organism: mutation and screening of improved cultures, random and strategic screening methods, strategies of strain improvement for primary, secondary metabolites with relevant examples. Media for industrial fermentation – characteristics of an ideal production medium – raw material – media formulation – sterilization – addition of antifoaming agents.

UNIT – II

Bioreactors: Design and Components of a basic Bioreactor, design features – parts, baffles, impellers, foam separators, sparger, culture vessel, cooling and heating devices, control of fermentation process – manual and computer control. Reactors for specialized applications: Tube reactor and packed bed reactors, fluidized bed reactors, cyclone reactors, trickle flow reactors, their basic construction and types for distribution of gases. Types of fermentation – Solid state, Submerged and liquid state. Kinetics of microbial growth in Batch, Fed Batch and Continuous cultures. Development of inoculums for various fermentation processes.

UNIT – III:

Gas exchange and Mass transfer: O2 transfer, critical oxygen concentration, determining the oxygen uptake rate. Heat transfer. Sterilization – processes, thermal death curve, in situ sterilization mixing and mass transfer, aeration and agitation – oxygenation, oxygen requirements, determination of KLa; Scale – Up and Scale – Down concepts.

UNIT – IV:

Downstream Processing: Recovery and Purification of fermentation of Products – Biomass separation by Flocculation and floatation, Filtration, Centrifugation, Coagulation and Flocculation, Cell disruption, Liquid extraction, Precipitation, Adsorption, Chromatography, Membrane Processes, Drying and Crystallization.

UNIT – V:

Production of metabolites and Fermentation Economics: Production of Industrial Alcohol – Ethanol, Organic Acids – Citric Acid, Amino Acid – Glutamic acid; Single Cell Protein Production, Yeast Production, Fermented foods from Milk – Cheese and Yoghurt, Beta – lactam antibiotics, Ergot alkaloids, Vaccines, Microbial Insecticides – *Bacillus thuringiensis*, Microbial enzymes, Bioplastics – Polyhydroxyalkanoates, Biofertilizers – *Rhizobium.* Economics of Overall production process, Costs for fermentation processing units and Downstream processing units, Capital costs, Operating costs, Labor costs, Utilities, Economic case for investment.

TEXT BOOKS:

1. Mansi EMTEL, Bryle CFA. (2007). ***Fermentation Microbiology and Biotechnology*** (2nd Edition), Taylor & Francis Ltd, UK.
2. Peppler H.J., D Perlma (2014). ***Microbial Technology: Fermentation Technology*** (2nd Edition), Academic press.
3. Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2017. ***Principles of Fermentation Technology*** (3rd Edition), Elsevier Ltd.
4. Glaser A.N & Nilaido. H (1995). ***Microbial Biotechnology***, (2nd Edition), W.H Freeman & Co.
5. Crueger. W and A. Crueger (2017). ***Biotechnology: A Textbook of IndustrialMicrobiology*** (3rd Edition), Sinauer Associates, Inc., Sunderland, Mass.

REFERENCE BOOKS:

1. Colin Ratledge and Bjorn Kristiansen, (2006). ***Basic Biotechnology*** (3rd Edition), Cambridge University Press.
2. G. Lancini, R. Lorenzetti. (2014). ***Biotechnology of Antibiotics and other BioactiveMicrobial Metabolites***, Springer publications, Germany.
3. Michael, L. Shulers and Fikret Kargi. (2002). Bioprocess Engineering: Basic concepts (2nd Edition), Prentice Hall Publishers.
4. Richard H. Baltz, Julian E. Davies, Arnold L. Demain (2010). ***Manual of Industrial Microbiology &Biotechnology*** (3rd Edition), ASM Press.
5. Reed, G. 1982. Prescott and Dunn's ***Industrial Microbiology*** (4th edition), CBS Publishers.

DIGITAL TOOLS:

1. https://onlinelibrary.wiley.com/doi/abs/10.1002/0471238961.06051813190 51407.a01.pub3
2. https://biologyease.com/types – of – fermentors/
3. https://www.toppr.com/ask/question/what – is – downstream – processing1/
4. https://unacademy.com/content/kerala – psc/study – material/general – microbiology/industrial – microbiology/microbial – processes – for – the – production – of – penicillin – and – alkaloids/
5. https://www.biotechfront.com/2021/12/control – system – devices – in – fermenter.html

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T		CREDITS
24PMBCP1	LAB IN GENERAL MICROBIOLOGY	CORE – 4 PRACTICAL – I	–		4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	40	60	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship

COURSE DESCRIPTION:

This course has been designed is to provide practical skills on basic microbiological techniques.

COURSE OBJECTIVES:

- To familiarize on basic microbiology techniques.
- To learn the basic microbial biochemistry methods.
- Isolation and identification of bacteria and fungi by pure culture technique.
- To know about the effect of environmental conditions on microbes.
- To prepare media for bacterial growth and measure the biomass of bacteria.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	To learn good microbiological practices, culture media preparation and various sterilization technique.	Upto K5
CO 2	To familiarize with aseptic techniques and Enumeration of bacteria and Fungi using pure culture technique	Upto K5
CO 3	To study morphological characters of bacteria and fungi through micrometry and staining technique	Upto K5
CO 4	Identification of bacteria through Biochemical test	Upto K5
CO 5	Gain knowledge in bacterial biomass using bacterial growth curve	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

LAB IN GENERAL MICROBIOLOGY

1. Sterilization, disinfection and safety in microbiological laboratory.
2. Media Preparation for cultivation of microorganisms.
3. Pure techniques – serial dilution – pour plate, spread plate, streak plate methods and stab culture techniques
4. Enumeration of bacteria – Soil, Water and Food sample
5. Enumeration of Fungi – Soil, Tree and Food Sample
6. Micrometry
7. Bacterial Staining methods – simple, Gram's, acid fast, flagella, capsule and spore.
8. Motility of bacteria
9. Fungal Staining methods – Lacto – phenol cotton blue
10. Identification of bacteria through Biochemical test
11. Bacterial growth curve

TEXT BOOKS:

1. By Hans G. Schlegel, C. Zaborosch, and M. Kogut (1993). ***General Microbiology*** /Cambridge University Press.
2. Chan E.C.S., Pelczar M. J. Jr. and Krieg N. R. (2010). ***Microbiology***. (5th Edition). Mc.Graw Hill. Inc, New York.
3. Prescott L. M., Harley J. P. and Klein D. A. (2004). ***Microbiology.*** (6th Edition).McGraw – Hill company, New York.
4. Prescott. L.M., Harley. J.P., Klein. D.A. (1993). ***Microbiology.*** 2nd edn. Wm. C. Brown publishers, Dubugue.
5. Stanier R.Y., Ingraham, J.L., Wheelis, M.L and Painter, P.R. (2010***). General Microbiology***. 5th Ed. Macmilan education Ltd. London.

REFERENCE BOOKS:

1. Tortora G. J., Funke B. R. and Case C. L. (2015). ***Microbiology: An Introduction*** (12th Edition). Pearson, London, United Kingdom.
2. Webster J. and Weber R.W.S. (2007). ***Introduction to Fungi.*** (3rd Edition). Cambridge University Press, Cambridge.
3. Salle. A.J. (1992). ***Fundamental Principles of Bacteriology***. 7th edn. McGraw Hill Inc.New York.
4. Ingraham, J.L. and Ingraham, C.A. (2000) ***Introduction to Microbiology***. (2nd Edition). Books / Cole Thomson Learning, UK.
5. Gottschalk, G. (1986). ***Bacterial Metabolism***.2nd Edn. Springer – Verlag, New York

DIGITAL TOOLS:

1. https://courses.lumenlearning.com/boundless – icrobiology/chapter/microbialnutrition/
2. https://www.lamission.edu/lifesciences/lecturenote/mic20/Chap06Growth.pdf
3. https://www.microbes.info/.

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBCP2	LAB IN MOLECULAR BIOLOGY AND MICROBIAL GENETICS	CORE – 5 PRACTICAL – II	–	6	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	40	60	100

NATURE OF COURSE	Employability		Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course has been designed to provide practical and technical knowledge on fundamentals of Molecular Biology and Microbial genetics.

COURSE OBJECTIVES:

- To learn the techniques for the amplification of biological molecules.
- Familiarize with routine molecular biological techniques.
- To understand the mechanism of genetic transfers in microbes.
- Illustrate the significance of artificial transformation and mutations.
- To understand different techniques used to study microbial genetics

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	To familiarize with molecular techniques associated with genomic and plasmid DNA isolation.	Upto K5
CO 2	Appreciate the methodology involved in quantification of DNA	Upto K5
CO 3	Comprehend the techniques involved in bacterial transformation	Upto K5
CO 4	Understand the mechanism of mutagenesis in bacteria thro physical and chemical mutagen	Upto K5
CO 5	Gain knowledge about isolation of antibiotic resistant microbes	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

LAB IN MOLECULAR BIOLOGY AND MICROBIAL GENETICS

1. Isolation of genomic DNA
2. Isolation of Plasmid DNA
3. Determination of quantity of DNA by spectrophotometric method.
4. Competent cell preparation and Bacterial transformation in E coli
5. Mutagenesis in given bacterial culture by U.V. radiation.
6. Isolation of auxotrophic mutants
7. Isolation of antibiotic resistant microbes
8. Polymerase Chain Reaction (Demo)
9. Blotting techniques (Southern, Northern and Western)

TEXT BOOKS:

1. Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Co. Ltd., New Delhi. Washington, D.C., USA
2. Freifelder, D. (1990). Microbial Genetics. Narosa Publishing House, New Delhi.
3. Nicholl, D.S.T. (2004). An Introduction to Genetic Engineering. 2nd Edition. Cambridge University Press, London.
4. Old, R.W. and Primrose, S.B. (1994) Principles of Gene Manipulation, Blackwell Science Publication, New York.
5. Sarma.P.V.G.K. (2021). Molecular Biology A Practical Manual. 1st edition, MJP Publisher, India

REFERENCE BOOKS:

1. Turner, P.C., Mclennan, A.G., Bates, A.D. and White, M.R.H. (1998). Instant Notes in Molecular Biology, Viva Books Pvt., Ltd., New Delhi.
2. Kannan, N. (2003). Hand Book of Laboratory Culture Medias, Reagents, Stains and Buffers. Panima Publishing Co., New Delhi.
3. Twyman, R.M. (2003). Advanced Molecular Biology. Viva books Pvt. Ltd. New Delhi.
4. Sinnot E.W., L.C. Dunn and T. Dobzhansky. (1958). Principles of Genetics. 5th Edition. McGraw Hill, New York.
5. Chaitanya. K.V.(2013). Cell and Molecular biology: A Lab Manual. Publisher PHB Learning .

DIGITAL TOOLS:

1. https://ruo.mbl.co.jp/bio/e/support/method/sds – page.html
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC93213/
3. https://us.vwr.com/store/category/uv – transilluminators/2993662

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBE11	MICROBIAL BIOCHEMISTRY	ELECTIVE – 1	4	–	3

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship
	☐	✓	☐

COURSE DESCRIPTION:

This course has been designed to build upon level knowledge of biochemical principles with specific emphasis on different microbial metabolic pathways.

COURSE OBJECTIVES:

- To know about the basic knowledge of biomolecules
- To understand carbohydrate metabolism in bacteria
- To understand the structure and metabolism of protein
- To analyze the structure and metabolic process of nucleic acid and vitamins
- To understand lipid metabolism and enzyme regulation

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Gain fundamental knowledge on structure, and molecular interaction of biomolecules.	Upto K5
CO 2	Become familiarize with the carbohydrate and energy metabolism in microbes.	Upto K5
CO 3	Understand the microbial protein structure and metabolism.	Upto K5
CO 4	Appreciate the metabolic pathways integrated in Nucleic acid and Vitamin synthesis.	Upto K5
CO 5	Gain knowledge about microbial enzymes and lipid biosynthesis	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

MICROBIAL BIOCHEMISTRY

UNIT – I:

Introduction to Basic Biochemistry – Structure of atoms and molecules. Molecular interactions – Hydrogen bonding, Covalent, Hydrophobic, Electrostatic and Vander Waals forces.

UNIT – II:

Carbohydrate & Energy metabolism – Structure, properties and classification of Carbohydrates. Anabolism – Catabolism – Embden – Mayer Hoff pathway – Entner Doudroff(ED) pathway – glyoxalate pathway – Krebs cycle – oxidative and substrate level phosphorylation – reverse TCA cycle,

UNIT – III:

Proteins structure & metabolism: Structure, properties and classification of Proteins. Proteins – primary – secondary – tertiary and quaternary structure. Structure and metabolism of amino acids.

UNIT – IV:

Structure and properties of nucleic acid bases, Nucleosides and nucleotides – Biosynthesis and degradation of purines and pyrimidines. Salvage pathway. Vitamins and Coenzymes**:** Structure and biochemical roles of fat and water – soluble vitamins and their coenzymes.

UNIT – V:

Microbial Enzymes & Lipid metabolism – Enzymes as biocatalysts, enzyme classification, specificity, active site, unit activity, isozymes. Enzyme kinetics: Michaelis – Menton equation for simple enzymes. Enzyme inhibition. Lipids – Structure, properties and classification of Lipids – Oxidation of Fatty acids, Structure and properties and biosynthesis of Cholesterol.

TEXT BOOKS:

1. Boyer R.F. (2002) ***Modern Experimental Biochemistry 3rd Edition.*** Pearson Education.
2. Wilson K., Walker J., Clokie S and Hofmann A. (2018) Wilson and Walker's ***Principles and Techniques of Biochemistry and Molecular Biology*** 8th Edition. Cambridge University Press.
3. Jain, J. L. J. &. S. J. &. N. (2022). *Fundamentals of Biochemistry*. S. Chand Publishing.
4. Lehninger, A.L., Nelson.D.L., Cox., M. M.2005 Lehninger Principles of Biochemistry, 5th ed. W. H. Freeman.
5. Satyanarayana, U. (2014). *Biochemistry*. Elsevier Health Sciences.

REFERENCE BOOKS:

1. Beedu Sasidhar Rao and Vijay Deshpande (2006) ***Experimental Biochemistry: A student companion*** IK International Pvt. Ltd
2. Sawhney, S.K and Randhir Singh (2001) ***Introductory Practical Biochemistry*** Narosa Pub House
3. Berg.J.M, Tymoczko.J.L, Stryer, L. , 2006. ***Biochemistry*** (6th ed). Freeman.
4. Murray,R.K., Rodwell,V.W., Bender, D., Botham, K.M., Weil, P.A. and Kennell, P.J. (2009). ***Harper's Illustrated Biochemistry,*** 28th Edition, McGraw Hill Professional publications.
5. Voet. D. and Voet. J.G. 2010. ***Biochemistry*** (4th ed.) John Wiley & Sons.

DIGITAL TOOLS:

1. https://egyankosh.ac.in/bitstream/123456789/68504/1/Unit – 2.pdf
2. https://bio.libretexts.org/Courses/Wheaton_College_Massachusetts/Principles_of_Biochemistry/08%3A_Carbohydrate_structure_and_metabolism
3. https://www.slideshare.net/devadevi666/protein – structure – presentation
4. https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200329161234 1624kuaum_yadav_structure_and_properties_of_Nucleic_acids.pdf
5. https://egyankosh.ac.in/bitstream/123456789/80282/1/Block – 3.pdf

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBE12	BIOPHYSICS AND BIOINSTRUMENTATION	ELECTIVE – 1	4	–	3

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability		Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course is broad – based in nature encompassing several new technologies that current experimental researchers are employing to probe complex system biology questions in life – sciences.

COURSE OBJECTIVES:

- To give knowledge about theories and methods of physics to understand working of biological system.
- To provide conceptual and hands – on practical knowledge to the student in the current research areas in the field of biophysics.
- Demonstrate knowledge and practical skills to develop the theory and practice of bio analytical techniques
- The main emphasis of biophysics is on the quantitative analysis of the physical and chemical aspects of the functions of biological molecules, organisms and entities.
- Update knowledge involving new methods in bio techniques and the bioinstrumentation.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Illustrate the basic principle and techniques to understand the general Biophysics	Upto K5
CO 2	Examine and practices the techniques of Chromatography and Spectroscopy	Upto K5
CO 3	Practice and report upon a range of experimental techniques which can be applied in the qualitative and quantitative analysis of biological molecules	Upto K5
CO 4	To gain knowledge in separation technique	Upto K5
CO 5	Explain the basics of radio isotopic and blotting techniques.	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

BIOPHYSICS AND BIOINSTRUMENTATION

UNIT – I:

Laws of conservation of energy – first and second laws and their relevance in the biological system, entropy, enthalpy, thermodynamic equilibrium, redox potential, Gibb's free energy, bioenergetics –endothermic and exothermic reactions of biological systems, energy change in the biological reactions. Electrical properties of biological compartments. Electricity as a potential signal, electrochemical gradients, membrane potential, ATP synthesis (chemiosmotic hypothesis).

UNIT – II:

Spectroscopy – Introduction – Theories exploring the concept of light: Corpuscular theory, Wave theory, Electromagnetic theory, Planck's concept and modern theory. Basic concepts, principles and biological applications of different types of spectroscopy: absorption spectroscopy, fluorescence spectroscopy, Infrared and Raman spectroscopy, LC – MS, GC – MS.

UNIT – III:

Macromolecular Structure Determination – Basics of X – ray Crystallography – Biological applications and interpretations. Basics of Magnetic resonance spectroscopy – biological application and interpretations of Nuclear Magnetic Resonance (NMR) & Electron Spin Resonance (ESR).

UNIT – IV:

Separation Techniques I (Chromatography) – Basics principles and applications of various chromatography methods: Partition and Absorption chromatography, gel filtration, ion – exchange and affinity chromatography, GC, HPLC and FPLC.

Separation Techniques II (Hydrodynamic Methods) – Basics of centrifugation – based methods: solvent fractionation, centrifugation, Biological applications and interpretations. Basics of electrophoresis: Biological applications and interpretation of different types of electrophoresis: SDS – PAGE, 2D Electrophoresis , Agarose Gel Electrophoresis, gradient gel, Iso – electric focusing.

UNIT – V:

Radioisotopic and blotting techniques: Radioisotopic techniques – Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger – Muller and Scintillation counters, autoradiography and its applications. Dosimetry – Principle, instrumentation, methods and applications of Western, Southern& Northern Blotting techniques.

TEXT BOOKS:

1. M. V. Volkenstein, · 2013, ***General Biophysics***: Volume II ,Academic press
2. N.d. HAari dass, ***Essentials of thermodynamics***, 2018, SRI Books, an imprint of the Simplicity Research Institute.
3. Veerakmari, l,(2019). ***Bioinstrumentation*** 2019, MJP Publisher.
4. Donald L. Wise. (1991). ***Bioinstrumentation and Biosensors***, CRC press
5. Clifford D. Ferris. (1979)**.** ***Introduction to Bioinstrumentation***, Humana Press

REFERENCE BOOKS:

1. Pranab Kumar Banerjee · 2008. ***Introduction to Biophysics***, S. Chand Limited.
2. M Subramanian · 2019, ***Biophysics Principles and Techniques***, MJP Publisher.
3. Andrey B. Rubin · 2014, ***Fundamentals of Biophysics***, Wiley publishers.
4. Clifford D. Ferris · 1979, ***Introduction to Bioinstrumentation***, ***With Biological, Environmental, and Medical Applications***, Humana Press.
5. John Enderle. (2022). ***Bioinstrumentation***, Springer International Publishing.

DIGITAL TOOLS:

1. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Electronic_Structure_of_Atoms_and_Molecules/Electronic_Configurations/Pauli_Exclusion_Principle
2. https://opentextbc.ca/biology/chapter/11 – 1 – homeostasis – and – osmoregulation/
3. https://www.cleaverscientific.com/what – is – electrophoresis/
4. https://www.geeksforgeeks.org/chromatography/
5. https://www.broadinstitute.org/technology – areas/what – mass – spectrometry

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBE13	NANO BIOTECHNOLOGY	ELECTIVE – 1	4	–	3

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	I	25	75	100

NATURE OF COURSE	Employability		Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

The course aims at providing a general and broad introduction to multi – disciplinary field of nanotechnology and its applications.

COURSE OBJECTIVES:

- To analyse nanomaterials based on the understanding of nanobiotechnology.
- Illustrate about the advanced biological nanomaterials and nanoparticles.
- Appraise the basic characterization of nanomaterials by various techniques.
- Application of nanobiotechnology in various field of biotechnonology.
- Develop and the discover nanomaterials for targeted drug and therapeutics.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Employ knowledge in the field of Nano biotechnology for development.	Upto K5
CO 2	Identify various applications of nanomaterials in thefield of medicine and environment.	Upto K5
CO 3	Examine the prospects and significance of nanobiotechnology.	Upto K5
CO 4	To explain the application of nanomaterial's in various fields.	Upto K5
CO 5	Identify recent advances in this area and create a career or pursue research in the field. design non–toxic nanoparticles for targeted drug delivery	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

NANO BIOTECHNOLOGY

UNIT – I:

Nanotechnology: Introduction to nanomaterials, Historical Developments, types of nanomaterials, Nanoparticle characterization – structural and chemical, Applications of Nanotechnology in microbial nanotechnology, nanomedicine, nanowires, quantum Dots, nanocomposite, nanoparticles.

UNIT – II:

Nanomaterials: Types of Nanocrystals – zero dimensional – one dimensional – two dimensional – three dimensional. Biological nanomaterials – Enzymes, DNA and RNA, Advanced nanomaterials – CNTs, Fullerenes. Role of plants in nanoparticle synthesis.Nanotoxicity assessment.

UNIT – III:

Basic characterization techniques – Electron microscopy, structural characterization by X – Ray Diffraction, XPS and advanced microscopy – TEM, SEM and Atomic force microscopy. Photon correlation Spectroscopy and optical characterization by FTIR, UV – Vis, DLS.

UNIT – IV:

Nanobiotechnology in Agriculture – Nano – based Agri and Food Products, food preservation and toxicity. Nano pesticides and Nano fertilizers, Nano – biostimulants and soil enhancers. Nanobiotechnology for Crop improvement. Nanotechnology for environment: contamination detection and remediation

UNIT – V:

Nanomaterial based Drug delivery and therapeutics–Nanostructures for diagnostics and biosensors. Nanoparticles for diagnostics and imaging – MRI, DNA and protein. Toxicology in nanoparticles.

TEXT BOOKS:

1. Brydson R. M., Hammond, C. (2005). ***Generic Methodologies for Nanotechnology: Characterization. In Nanoscale Science and Technology.*** John Wiley & Sons, Ltd.
2. Leggett G. J., Jones R. A. L. (2005). ***Bionanotechnology. In Nanoscale Science and Technology***. John Wiley & Sons, Ltd.
3. Mohan Kumar G. (2016). ***Nanotechnology: Nanomaterials and nanodevices***.Narosa Publishing House.
4. Goodsell D. S. (2004). ***Bionanotechnology***. John Wiley & Sons, Inc.
5. PradeepT. (2007).***Nano: The Essentials–Understanding nano science and nanotechnology***. Tata McGraw–Hill.

REFERENCE BOOKS:

1. Nouailhat A. (2008). ***An Introduction to Nanoscience and Nanotechnology***,Wiley.
2. Sharon M. and Maheshwar (2012). ***Bio–Nanotechnology: Concepts and Applications.*** New Delhi. Ane books Pvt Ltd.
3. Niemeyer C.M. and Mirkin C. A. (2005). ***Nanobiotechnology***. Wiley Inter science.
4. Rehm, B. (2006). ***Microbial Bionanotechnology: Biological Self– Assembly Systems and Biopolymer–Based Nanostructures***. Horizon Scientific Press.
5. Reisner, D.E. (2009). ***Bionanotechnology: Global Prospects.*** CRC Press

DIGITAL TOOLS:

1. https://www.gale.com/nanotechnology
2. https://www.understandingnano.com/resources.html
3. http://dbtnanobiotech.com/index2.php
4. http://www.istl.org/11 – winter/internet1.html
5. https://www.cdc.gov/niosh/topics/nanotech/default.html

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	**2**	**3**	**3**	**2**
CO2	**3**	**2**	**2**	**3**
CO3	**3**	**3**	**2**	**2**
CO4	**2**	**3**	**2**	**3**
CO5	**3**	**3**	**2**	**3**

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE STRUCTURE – II SEMESTER

S. No.	Course Code	Course Title	Hrs./ Week	Exam (Hrs.)	CA	SE	Total	Credits
1.	24PMBC21	**Core – 6:** Genetic Engineering	5	3	25	75	100	4
2.	24PMBC22	**Core – 7:** Immunology	4	3	25	75	100	4
3.	24PMBC23	**Core – 8:** Bioinformatics and Microbial Omics	5	3	25	75	100	4
4.	24PMBCP3	**Core – 9: Core Practical – III:** Lab in Immunology	6	3	40	60	100	4
5.	24PMBCP4	**Core – 10: Core Practical – IV:** Lab in Genetic Engineering and Bioinformatics	6	3	40	60	100	4
6.	24PMBE21	**Elective – 2: *** Microbial Ecology and Toxicology	4	3	25	75	100	3
	24PMBE22	Biomass and Bioenergy						
	24PMBE23	Medical Virology and Parasitology						
7.		Internship	–	–	–	–	–	–
		TOTAL	**30**					**23**

***One elective course to be chosen from THREE courses**

CA – Class Assessment (Internal)

SE – Summative Examination

T – Theory

P – Practical

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBC21	GENETIC ENGINEERING	CORE – 6	5	–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability		Skill Oriented	✓	Entrepreneurship	✓

COURSE DESCRIPTION:

This course has been designed to acquaint students with various approaches ofrecombinant DNA technology and their applications in biological research / industries.

COURSE OBJECTIVES:

- To familiarize the students with the basic concepts in genetic engineering.
- To acquaint the students to versatile tools and techniques employed in geneticengineering and recombinant DNA technology
- To illustrate creative use of modern tools and techniques for manipulation andanalysis of genomic sequences.
- To expose students to the applications of recombinant DNA technology inbiotechnological research.
- To train students in strategizing research methodologies employing geneticengineering techniques

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Gain knowledge on tools and strategies used in genetic engineering	Upto K5
CO 2	Design cloning experiments for applications invarious genomic and proteomics studies.	Upto K5
CO 3	Identify, select and implement the PCR and its types in molecular biologyand recombinant DNA technology.	Upto K5
CO 4	Apply knowledge of genetic engineering in current applications of biotechnology. 6. comprehend	Upto K5
CO 5	Comprehend and analyze the impact of gene silencing and antisense technology	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

GENETIC ENGINEERING

UNIT – I:

Introduction to gene cloning – Enzymes used in genetic engineering: restriction endonucleases, type I, II, III, recognition sequences, properties, nomenclature, classification of type II endonucleases, their activity. DNA ligase: Properties and specificity, S1 nuclease, BAL 31 nuclease, DNA polymerase, polynucleotide kinase, phosphatase, reverse transcriptase – its activity and mode of action. Restriction digestion, ligation and transformation.

UNIT – II:

Cloning and Expression Vectors: Vehicles for gene cloning, Plasmids, Bacteriophages, Cosmids and Phagemids as vectors, P1 vectors, Plant and animal viruses as vector, Artificial chromosomes as vectors (YAC, BAC, PAC and MAC vectors), Expression vectors – use of promoters and expression cassettes, Baculovirus vectors system, plant based vectors, Ti and Ri as vectors, yeast vectors, Binary and shuttle vectors.

UNIT – III:

Gene Manipulation and Protein – DNA Interaction: Insertion of foreign DNA into hostcells; transformation, electroporation, transfection; Screening and selection ofrecombinants: Insertional inactivation – antibiotic resistant genes – Lac Z' gene – Blue white screening – α complementation – colony hybridization – construction of libraries; isolation of mRNA and total RNA; reverse transcriptase and cDNA synthesis; cDNA and genomic libraries; construction of microarrays – genomic arrays, cDNA arrays and oligo arrays; Principles for maximizing gene expression, Protein purification; His – tag; GST – tag etc.; Protein – DNA interactions.

UNIT – IV:

PCR Techniques: Principles of PCR: primer design; fidelity of thermostable enzymes; DNA polymerases; types of PCR – multiplex, nested; reverse – transcription PCR, real time PCR, touchdown PCR, hot start PCR, colony PCR, asymmetric PCR, cloning of PCR products. Recombinant DNA technology with reference to cloning and production of human growth hormone (insulin somatotropin), vaccines (hepatitis B virus vaccine, FMD vaccine), interferons, tPA.

UNIT – V:

Gene Silencing and Genome Editing Technologies: Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; gene knockouts and gene therapy.Gene downregulation – using antisense RNA, dsRNA and co – suppression, CRISPR – cas 9. Site directed mutagenesis (PCR based methods).Applications of genetic engineering: transgenic animals (knockout mice) and plants (Flavr savr tomato), DNase foot printing, gene therapy (in vitro and in vivo methods). Biosafety regulation: Physical and biological contaminants

TEXT BOOKS:

1. Clark DP and Pazdernik NJ. (2015). ***Biotechnology – Applying the GeneticRevolution*** (2nd Edition). Elsevier Academic Press, USA.
2. Brown T.A. (2020). ***Gene Cloning & DNA Analysis*** (8th Edition.) Wiley – Blackwell,New York.
3. Watson J.D. (2009). ***A Passion for DNA: Genes, Genomes & Society***, ColdSpring Harbor Laboratory press (CSHL).
4. Bernard R. Glick and Cheryl L. Patten. (2022). ***Biotechnology – Principles and Applications of Recombinant DNA*** (6th Edition), ASM Press, Washington, D.C
5. Primrose, S.B. & Twyman R.M. (2013). ***Principles of Gene Manipulation andGenomics*** (7th Edition.). Malden, MA: Blackwell Publisher.

REFERENCE BOOKS:

1. Sambrook, J and Russell, D.W. (2001). ***Molecular Cloning: A LaboratoryManual*** 3rd Edition. Cold Spring Harbor Laboratory Press.
2. Nair, A. J (2008). ***Introduction to Genetic Engineering and Biotechnology.*** Infinity Science Press.
3. Robert Williamson (2014). Genetic Engineering (1st Ed.) Academic Press. USA
4. Nicholl D.S.T(2002). ***An introduction to Genetic Engineering*** 2nd edition. Cambridge University Press.
5. Joceyln E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick (2017). ***Lewin's GENES XII*** 12th Edition. Jones & Barlett Learning.

DIGITAL TOOLS:

1. https://microrao.com/micronotes/genetic_engineering.pdf
2. https://bio.libretexts.org/Bookshelves/Genetics/Genetics_Agriculture_and_Biotechnology_(Suza_and_Lee)/01%3A_Chapters/1.11%3A_Recombinant_DNA_Technology
3. https://microbenotes.com/recombinant – dna – technology – steps – applications – and – limitations/
4. https://www.hudsonalpha.org/recombinant – dna – and – genetic – engineering/
5. https://avys.omu.edu.tr/storage/app/public/hmaksoy/109715/Biotechnology%202.pdf

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBC22	IMMUNOLOGY	CORE – 7	4	–	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability		Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course has been designed to familiarize students with cellular, molecular, and biochemical aspects of the development of the immune system and the immune response. The course focuses on the development of the immune system and the function of itsmajor components.

COURSE OBJECTIVES:

- To introduce students about structural features of components of immune system aswell as their function
- To train the students to apply the knowledge of basic Immunology to identifyproblems and formulate solutions for the protection of human health.
- To introduce students the theories of different immunological techniques
- To prepare the students to explore strategies to improve existing vaccines.
- To expose students to immune modulatory strategies that can be used to enhanceimmune responses or to suppress unwanted immune responses during different immune disorders.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Understand types of immunity and maturation and regulation of T and B cell	Upto K5
CO 2	Understand complement component and its activation and regulation	Upto K5
CO 3	Recognize the significance of Antigen – antibody interactions	Upto K5
CO 4	Identify the magnitude of Clinical Immunology.	Upto K5
CO 5	Gain knowledge in tumor immunology and immunodeficiency	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

IMMUNOLOGY

UNIT – I:

Types of immunity – innate and adaptive, humoral and cell – mediated immunity; lymphoid organs – primary and secondary; cells of the immune system; immunogens and antigens – characteristics, classes of antigens; MHC – Structure and regulation of its expression; Role of APCs and TCR in antigen processing and presentation; Maturation, activation and differentiation of B and T cells. Regulation of B cell development and immune response;

UNIT – II:

Immune effector mechanisms: Cytokines – types and receptors; Complement– Components, their functions and activation; Biological consequences of complement activation and regulation; General properties of effector T cells, Cytotoxic T cells, and NK cells.

UNIT – III:

Antibody – structure, types & functions. Generation of antibody diversity. Antigen – antibody Interactions: Precipitation, agglutination and complement mediated immune reactions. Cytotoxicity assays, Apoptosis, microarrays, transgenic mice, gene knock outs. Agglutination based assays – WIDAL, VDRL, precipitation based assay – Ig quantification by SRID and Effector cell assays – ELISA .

UNIT – IV:

Clinical Immunology – Immunity to Infection: Bacteria, viral, fungal and parasitic infections. Hypersensitivity – Type I – IV. Autoimmunity; Types of autoimmune diseases; Transplantation –types of grafts – allograft rejection & its mechanism – immunosuppression – Graft – vs host disease – fetus as allograft.

UNIT – V:

Immune deficiency disorders – Tumor immunology –Tumor antigens; Immune response to tumors, Cancer immunotherapy. Immunodeficiency – Primary immune deficiencies, Acquired or secondary immune deficiencies.

TEXT BOOKS:

1. Punt, J., Stranford, S., Jones, P. & Owen, J.A. (2018) ***Kuby Immunology*** (8thEd.). Macmillan International Higher Education.
2. Delves, P.J., Martin, S.J., Burton, D.R. & Roitt. I.M. (2017) ***Roitt's EssentialImmunology*** (13th Ed.). Wiley – Blackwell Publishers.
3. Kenneth, M. & Weaver, C. (2016) ***Janeway's Immunobiology*** (9th Ed.). GarlandScience.
4. Tizard, I. (1994) ***Immunology: An Introduction*** 4th edition. Cengage LearningPublishers.
5. Rao C. V. (2016). ***Immunology: A Textbook.*** Narosa Publishing House Pvt. Ltd. – New Delhi

REFERENCE BOOKS:

1. Chakravarthy,A.K.(2006) ***Immunology and Immunotechnology***. OxfordUniversity Press.
2. Lombard, M.F., Coleman, R.M., Sicard,R.E.(1999) ***Fundamental Immunology*** 2nd edition. McGraw – Hill Higher Education.
3. Khan,F.H. (2009) ***The Elements of Immunology*** 1 st edition. Pearson Publishers.
4. Abbas, A.K., Lichtman,A.H.H., Shiv Pillai (2011) ***Cellular and MolecularImmunology*** 7 th edition. Elsevier Saunders Publishers.
5. Roohi Bansal, (2021). ***Antibodies and Their Role in Therapeutics.*** Publisher Roohi Bansal.

DIGITAL TOOLS:

1. https://microbenotes.com/category/immunology/
2. https://www.ncbi.nlm.nih.gov/books/NBK7795/
3. https://www.bellarmine.edu/faculty/mlassiter/documents/BasicImmunologyoptometryuk.pdf
4. https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Boundless)/11%3A_Immunology
5. https://ocw.mit.edu/courses/hst – 176 – cellular – and – molecular – immunology – fall – 2005/pages/lecture – notes/

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**3**	**2**
CO2	**2**	**3**	**1**	**3**
CO3	**3**	**3**	**2**	**1**
CO4	**2**	**1**	**3**	**2**
CO5	**1**	**3**	**2**	**3**

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T		CREDITS
24PMBC23	BIOINFORMATICS AND MICROBIAL OMICS	CORE – 8	5		4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability ☐	Skill Oriented ☐	Entrepreneurship ☐

COURSE DESCRIPTION:

This course has been designed to gain insight in the analytical principles behind omics – technologies such as array – based analysis (PCR, DNA sequencing), 2D and capillary electrophoresis, mass spectrometry, NMR and advanced statistical and data informatics. It will discuss the information that can or cannot be obtained by the different 'omics' – approaches, and in the novel developments of omics – applications such as miRNA arrays, analysis of the epigenome, and next generation sequencing.

COURSE OBJECTIVES:

- To make the students understand how all the genes in a genome act and how their products interact to produce a functional organism.
- To develop an understanding of basic theory of bioinformatics tools
- To introduce students the different methods of sequencing, microarrays, protein fingerprints.
- To prepare the students to explore the bioinformatics tools applied to analyse and interpret the protein – protein interactions.
- To make the students appreciate the surplus value of combining data from different omics – applications as a systems approach.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Utilize bioinformatics tools and databases for retrieving, analyzing, understanding and managing biological data.	Upto K5
CO 2	Become familiar with Sequence analysis computational methods	Upto K5
CO 3	Recognize the significance of Global patterns of gene expression	Upto K5
CO 4	Understanding of genomic data into analytical knowledge	Upto K5
CO 5	Learn basic concepts in Proteomics and their role in Life Science Research.	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

BIOINFORMATICS AND MICROBIAL OMICS

UNIT – I:

Bioinformatics and its applications – Databases, types, pairwise and multiple alignments. Structure – function relationship. Sequence assembling using computers. Computer applications in molecular biology, Protein domains and human genome analysis program (BLAST, FASTA, GCC etc.) Search and retrieval of biological information and databases sequence, databank. (PDB and gene bank), accessing information (Network expasy, EMB Net, ICGEB Net).

UNIT – II:

Sequence analysis Computational methods, homology algorithms (BLAST) for proteins and nucleic acids, open reading frames, annotations of genes, conserved protein motifs related structure / function (PROSITE, PFAM, Profile Scan). DNA analyses for repeats (Direct and inverted), palindromes, folding programmes. Use of Internet, public domain databases for nucleic acid and protein sequences (EMBL, Gene Bank), database for protein structure (PDB).

UNIT – III:

DNA Microarray Printing – Whole genome analysis for Global patterns of gene expression using fluorescent – labelled cDNA or end labelled RNA probes. Analyses of single nucleotide polymorphism using DNA chips.

UNIT – IV:

Proteome analysis Two – dimensional separation of total cellular proteins, isolation and sequence analysis of individual protein spots by Mass Spectroscopy. Protein microarray advantages and disadvantages of DNA and protein microarrays.

UNIT – V:

Meta genomics – construction, vector design and screening of meta genomic libraries – biotechnological applications of meta genomics. Whole genome analysis – Preparation of ordered cosmid libraries, bacterial artificial chromosomal libraries, shotgun libraries and sequencing, conventional sequencing (Sanger, Maxam and Gilbert Methods), automated sequencing.

TEXT BOOKS:

1. Brown T. A. (2007), ***Genomes 3***. Garland Science Publishing, New York.
2. Dunham, I., (2003). ***Genome Mapping and sequencing***. Horizon Scientific Press
3. Malcolm Campbell and Laurie J. Heyer. (2006) ***Discovering Genomics, Proteomics and Bioinformatics*** 2nd edition, Cold Spring Harbor Laboratory Press.
4. Pevsner, J., John Wiley and Sons (2015) ***Bioinformatics and Functional Genomics*** (3rd Ed.) by, New Jersey, USA.
5. De Sousa, C.S., Hassan, S.S., Pinto, A.C., Silva, W.M., De Almeida, S.S., Soares, S.D.C., Azevedo, M.S., Rocha, C.S., Barh, D. and Azevedo, V., (2018). ***Microbial omics: applications in biotechnology***. In Omics technologies and bio – engineering. Academic Press.

REFERENCE BOOKS:

1. Primrose, S.B. and Twyman, R.M., (2003). ***Principles of Genome Analysis and Genomics*** (3rd Ed.) by Blackwell Publishing Company, Oxford, UK.
2. Liebler, D.C. (2002) ***Introduction to Proteomics – Tools for the new biology*** (1st Ed.) by Humana Press Inc., New Jersey, USA.
3. Mount, D. (2004) ***Bioinformatics: Sequence and Genome Analysis***, Cold Spring Harbor Laboratory Press, New York.
4. Taymaz – Nikerel, H. and Lara, A.R.., (2016). ***Quantitative systems biology for engineering organisms and pathways***. Frontiers Media SA.L
5. Aizat, W.M., Goh, H.H. and Baharum, S.N. eds., (2018). ***Omics applications for systems biology*** (Vol. 1102). Cham, Switzerland: Springer International Publishing.

DIGITAL TOOLS:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=5097
2. https://microbenotes.com/difference – between – genomics – and – proteomics/
3. https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/General_Biology_1e_(OpenStax)/3%3A_Genetics/17%3A_Biotechnology_and_Genomics/17.5%3A_Genomics_and_Proteomics
4. https://microbenotes.com/difference – between – genomics – and – proteomics/

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**3**	**2**
CO2	**2**	**3**	**1**	**3**
CO3	**3**	**3**	**2**	**1**
CO4	**2**	**1**	**3**	**2**
CO5	**1**	**3**	**2**	**3**

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBCP3	LAB IN IMMUNOLOGY	CORE – 9 PRACTICAL – III	–	6	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	40	60	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship
	☐	☐	☐

COURSE DESCRIPTION:

This course has been designed to develop an understanding about practical aspects of components of immune system as well as their function.

COURSE OBJECTIVES:

- To demonstrate the features, principles and procedures of immunological testing and interpretation of their finding.
- To prepare the students to use advance and smart immunological devices for analyzing the patient's serum, whole blood and others clinical specimens.
- To make the students work collaboratively and constructively, and lead diverse teams to perform a wide range of immunological experiments with responsibility.
- To provide the students technical knowledge on the collection and processing of clinical samples
- To offer hands – on experience in basic immunological techniques for the determination of microorganisms in biological fluids and other samples

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Elucidate the principles of and perform blood grouping and morphology identification of immune cells	Upto K5
CO 2	Know concepts of antigen, antibodies and their interactions.	Upto K5
CO 3	Describe the principals involved in the immune response.	Upto K5
CO 4	Gain knowledge in enumeration of RBC in human blood	Upto K5
CO 5	Understand the theory of immunological basis of tests used for diseases.	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

LAB IN IMMUNOLOGY

1. Haematological reactions – Blood Grouping – forward and reverse, Rh Typing
2. Identification of various immune cells by morphology –Leishman staining, Giemsa staining.
3. Widal, slide and tube agglutination test
4. Latex agglutination test – RA – test, CRP – test, ASO – test
5. Determination of differential leukocyte count.
6. Isolation and enumeration of RBC from human blood
7. ELISA (Demo) Immuno – electrophoresis and staining of precipitin lines
8. Rocket immuno electrophoresis and counter current immuno electrophoresis

TEXT BOOKS:

1. Hudson. L. and Hay, F. C. (1989), ***Practical Immunology***(3rd ed).Oxford: Blackwell Scientific Publications.
2. Abul. K. Abbas, Andrew. H.H, Lichtman & Shiv Pillai (2015). ***Basic Immunology, Functions, and Disorders of the Immune System*** (5th ed). Elsevier.
3. Abul. K. Abbas & Andrew H. Lichtman & Shiv Pillai (2014). ***Cellular and Molecular Immunology*** (8th ed). Elsevier.
4. Barbara,J.A.,Regan,F.A.,&Contreras,M.(Eds.).(2008).***Transfusionmicrobiology.***Cam bridgeUniversityPress.

REFERENCE BOOKS:

1. Noel. R. Rose, Herman Friedman, John. L. Fahey (1986). ***Manual of Clinical Laboratory Immunology***, American Society for Microbiology.
2. Patrick. R. Murray, Ellen Jo Baron, James Jorgensen, Michael Pfaller, Marie Louise Landry. (2007). ***Manual of Clinical Microbiology***:2Volume Set(9th Revised) American Society for Microbiology.
3. Rastogi S. C.(1996). ***Immunodiagnostics Principles and Practice.*** New Delhi. New Age International (P)Ltd.
4. Talwar, G.P. (1983). ***A Handbook of Practical Immunology***. New Delhi: Vikas Publishing House Pvt. Ltd.

DIGITAL TOOLS:

1. https://www.technologynetworks.com/analysis/articles/western – blot – procedures – analysis – and – purpose – 353918
2. https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Boundless)/07%3A_Microbial_Genetics/7.13%3A_Bioinformatics/7.13E%3A_Amplifying_DNA_–
3. _The_Polymerase_Chain_Reaction
4. https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/med_lab_tech_students/serology.pdf
5. https://www.clinical – laboratory – diagnostics.com/k42.html

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBCP4	LAB IN GENETIC ENGINEERING AND BIOINFORMATICS	CORE – 10 PRACTICAL – IV	–	6	4

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	40	60	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship

COURSE DESCRIPTION:

This course has been designed to provide students with experimental knowledge of molecular biology and genetic engineering. This practical course also aims to impart training in bioinformatics methods by various software packages.

COURSE OBJECTIVES:

- To provide students with laboratory experimental knowledge of molecular biology, genetic engineering and rDNA Technology aspects.
- To teach students with different approaches to perform molecular biology, genetic engineering, rDNA technology and their practical applications in biotechnological research as well as in pharmaceutical industries.
- To gain hands on experience in gene isolation, cloning by PCR approach, DNA on and PCR amplification for DNA fingerprinting analysis via RAPD and restriction digestion.
- To make students expertise in isolation of plasmids and transformation into suitable bacteria for selection of recombinant clones.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Gain hands – on experience in isolation auxotrophic mutants	Upto K5
CO 2	Understand restriction enzyme digestion of plasmid DNA and transformation in bacteria	Upto K5
CO 3	Describe contents and properties of most important bioinformatics databases	Upto K5
CO 4	Explain major steps in pairwise and multiple sequence alignment, explain principle and execute pairwise sequence alignment by dynamic programming.	Upto K5
CO 5	Predict secondary and tertiary structures of protein sequences	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

LAB IN GENETIC ENGINEERING AND BIOINFORMATICS

Section A) Recombinant DNA Technology:

1. Isolation of streptomycin – resistant mutants using gradient plate technique.
2. Plasmid DNA isolation and DNA quantitation
3. Restriction Enzyme digestion of plasmid DNA
4. Transformation of E.coli with standard plasmids
5. Uninterrupted bacterial conjugation

Section B) Bioinformatics

1. Introduction to biological databases
2. Sequence retrieval from various data base – NCBI, Swissprot, PIR
3. Similarity searching through BLAST
4. Perform Multiple sequence alignment using Clustal W
5. Find out he evolutionary database between the nucleic acid protein sequence using phylogenetic tree
6. Use of gene prediction methods (GRAIL, Genscan, Glimmer).
7. Using RNA structure prediction tools(tRNASCAN)
8. Use of various primer designing and restriction site prediction tools (NetPrimer)
9. Use of different protein structure prediction databases (PDB, SCOP, CATH).
10. Construction and study of protein structures using Deepview/PyMol.

TEXT BOOKS:

1. Green, M. R., & Sambrook, J.(2012.) ***Molecular Cloning: a Laboratory Manual***. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
2. Mount, D.W.(2001.) ***Bioinformatics: Sequence and Genome Analysis***. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

REFERENCE BOOKS:

1. Baxevanis, A.D., & Ouellette, B.F.(2001.) ***Bioinformatics: a Practical Guide to the Analysis of Genes and Proteins.*** New York: Wiley – Interscience. 2001.
2. Pevsner, J. (2015)***Bioinformatics and Functional Genomics***. Hoboken, NJ: Wiley – Blackwell..
3. Lesk, A.M.(2004) ***Introduction to Protein Science: Architecture, Function, andGenomics***. Oxford: Oxford University Press.

DIGITAL TOOLS:

1. https://www.protocols.io/view/pcr – cloning – with – blue – white – selection – and – easy – ins – t89erz6.html
2. https://amidbiosciences.com/products/pbr322 – plasmid – dna – cloning – vector
3. https://www.ncbi.nlm.nih.gov/
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3531099/

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBE21	MICROBIAL ECOLOGY AND TOXICOLOGY	ELECTIVE – 2	4	–	3

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability	Skill Oriented	Entrepreneurship

COURSE DESCRIPTION:

This course is designed to gain a basic understanding of the current methodologies used for surveying soil microbial diversity and the environmental factors influencing microbial distribution and abundance. This course covers the basic aspects of microbial toxicology which includes the structure and properties of microbial toxins and methods of identification of microbial toxins at cellular level.

COURSE OBJECTIVES:

- To make the students obtain in depth knowledge about microbial communities and ecosystem.
- To develop knowledge about quantitative ecology.
- To Recognize the various categories of environmental toxins and their hazardous consequence
- To enhance the knowledge of underlying etiology of bacterial diseases.
- To illustrate various techniques to isolate and characterize the toxin. Examine, interpret and discuss the certainty of toxic substances.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	Predict community ecosystem and their dynamics.	Upto K5
CO 2	Apply quantitative microbial ecology for the benefit of mankind.	Upto K5
CO 3	Perceive the adverse effects of toxin and its potential	Upto K5
CO 4	Assess the toxicity, properties and mode of actions of bacterial toxins.	Upto K5
CO 5	Evaluate the toxicity level with the help o f advanced techniques.	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

MICROBIAL ECOLOGY AND TOXICOLOGY

UNIT – I:

Microbial Communities and Ecosystems – Development of microbial community. Microbial community and dynamics and nature. Succession within biofilm communities.

UNIT – II:

Quantitative Microbial Ecology – Sample collection, detection of microbial populations, determination of microbial numbers, detecting non culturable bacteria and determination of microbial biomass.

UNIT – III:

General Introduction – Definition of toxins, different categories of toxins.Bacterial toxins – Bacterial toxins Bacterial toxinogenesis, endotoxins, exotoxins, exotoxins, bacterial protein toxins with special reference to cholera, diphtheria and tetanus toxins, molecular mechanism of action of endotoxins, exotoxins, enterotoxins, neurotoxins and mycotoxins.

UNIT – IV:

Fungal Toxins – Structure, Properties of Aflatoxin, OchratoxinPatulin, Leukosytrine, Trichothecenes, Fumonisins and Ergot alkaloids.

UNIT – V:

Algal Toxins – Structure, Properties of CyanotoxinsMicrocystins, Nodularins, Anatoxin – A, SaxitoxinAetokthonotoxin. Others – Hepatotoxin, Neu.

TEXT BOOKS:

1. McArthur. (2006). ***Microbial Ecology*** – An Evolutionary Approach AP Publishers.
2. SubbaRao. N.S. (2005). ***Soil microorganisms and Plant Growth***. (4th Edition). Oxford and IBH PublishingPvt. Ltd.
3. Shier W. T. (1990). ***Handbook of Toxicology***. CRC Press. ISBN 9780824783747
4. Wilson K. and Walker J. (2010). ***Principles and Techniques of Biochemistry and Molecular Biology.*** (7thEdition). Cambridge University Press India Pvt.Ltd. ISBN 1 – 4051 – 3544 – 1
5. Cora Lancester. (2015). ***Molecular Toxicology Handbook***. Callisto Reference

REFERENCE BOOKS:

1. Tinsley, S. and Pillai, I. (2012). ***Environmental Management Systems*** – Understanding Organizational Drivers and Barriers. Earth scan.
2. Reilly M. J. (2018). ***Bioinstrumentation.*** CBS Publishers and Distributors Pvt Ltd. ISBN 13 978 – 8123928395.
3. Greenberg M., Hamilton R., Phillips S. and McCluskey G. J. (2003). Occupational, ***Industrial and Environmental Toxicology***. St Louis: C.V. Mosby.
4. Wiley – Vch. (2005). Ullmann's ***Industrial Toxicology***. New York: John Wiley & Sons.
5. Winder C. and Stacey N.H. and Boca Raton F. L. (2004). ***Occupational Toxicology***. (2nd Edition). CRC Press

DIGITAL TOOLS:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5869414/
2. https://www.reseachgate.net/publication/269037373_TOXIN_AS_A_MEDICINE
3. https://pubmed.ncbi.nlm.nih.gov/12807310

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBE22	BIOMASS AND BIOENERGY	ELECTIVE – 2	4	–	3

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability		Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course provides an understanding on the sustainable utilization of biomass fuels and in – depth knowledge of fuel characterization, treatment and conversion technologies using environmental microorganisms related to bioenergy.

COURSE OBJECTIVES:

- To make the students Acquire knowledge on bioenergy utilizing organic wastes for energy recovery.
- To discuss methods and strategies of exploiting microbes for the production technology of biodiesel.
- To describe the students the resources and techniques for the production and estimation of eco – friendly biofuels and the extent of their use potentially.
- To make the students gain knowledge for executing biogas plant in communities.
- To explain the students the possibility of using microbes for the production of bio – hydrogen as a source of future fuel.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	To know important contemporary topics in the field of environmental science especially in the area of climate change	Upto K5
CO 2	Gain more knowledge about the overview of energy sources and technologies and the social and economic implications of energy uses	Upto K5
CO 3	Understand the mechanism of greenhouse gas emissions and international concern about climate change and mitigation efforts	Upto K5
CO 4	Gain knowledge in biofuel and hydrogen production	Upto K5
CO 5	Acquire more information about carbon credit and mitigation techniques.	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

BIOMASS AND BIOENERGY

UNIT – I:

Biomass resource assessment: Classification and properties of biomass, Biomass characterization, different energy conversion methods, Bio Energy Resources, World Bio Energy Potential, India's Bio – Energy Potential, Biomass Resources and classification, Physio – chemical characteristics. Biomass Combustion, Loose biomass densification, Biomass – based power generation and utilization for domestic cooking, improved biomass cookstoves

UNIT – II:

Biogas Systems: Technology of Biogas production, Biogas Plants, Digester types, Digester design, Chemical kinetics and mathematical modelling of bio methanation process, Dung, Vegetable Waste and Municipal Waste based Biogas plants, Biogas as fuel for transportation, Electricity generation, Application of Biogas slurry in agriculture, Design of Biogas for cold climates

UNIT – III:

Energy Sources Environment and sustainable development – Energy sources – Sun as the source of energy – Photosynthesis – Classification of energy sources – Fossil fuel reserves and resources – Overview of global/ India's energy scenario

UNIT – IV:

Biofuel: Bioethanol production from lignocelluloses, waste material, including crop residue, sugar, and starch; biodiesel production from vegetable oil and animal fat, algae; biofuel derived from; economics of biofuel production; environmental impacts of biofuels; biofuel blends; green diesel from vegetable oil; biodiesel production process, by – product utilization. Production of biohydrogen; production of hydrogen by fermentative bacteria

UNIT – V:

Bio – refinery concept: Bio – refinery concept: definition; different types of bio – refinery; challenges and opportunities; Fuel and chemical production from saccharides, lignocellulosic biomass, protein; vegetable oil; algal biorefinery.

TEXT BOOKS:

1. Dahiya A. (2014). ***Bioenergy*** – Biomass to Biofuel. (1st Edition). Academic Press Editor.
2. Brown R. C. (2003). ***Biorenewable Resources***: Engineering New Products from Agriculture. (1st Edition). Wiley Blackwell Publishing.
3. Jawaid M., Hakeem K. R. and Rashid U. (2014). ***Biomass and Bioenergy***: Processing and Properties. (1st Edition). Springer Cham.
4. Caye M. Drapcho, Tery H. Walke***Biofuels Engineering Process Technology***. McGraw Hill.
5. Teri. ***Bio energy powering the Future***. Pearson Longman Publications.

REFERENCE BOOKS:

1. John Wiley & Sons. Bhatia, S.C. (2014). ***Advanced Renewable Energy Systems,*** Part –II, WPI Publishers
2. Lee Sunggyu. (2012). ***Biofuels and Bioenergy: Process and Technologies.*** CRC
3. Boyle, G.(2012). Renewable Energy: Power for a Sustainable Future. Oxford
4. Dahiya, A. (Ed.). (2014). ***Bioenergy: Biomass to biofuels***. Academic Press.
5. San Pietro, A. (Ed.). (2012). ***Biochemical and photosynthetic aspects of energy production***. Elsevier. New York

DIGITAL TOOLS:

1. https://www.elsevier.com Biofuels and Bioenergy
2. https://www.sciencedirect.com › book › bioenergy
3. https://www.energy.gov/eere/bioenergy/bioenergy – basics
4. https://www.iea.org/fuels – and – technologies/bioenergy

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	**3**	**2**	**1**	**3**
CO2	**2**	**3**	**3**	**2**
CO3	**1**	**3**	**3**	**3**
CO4	**3**	**1**	**2**	**3**
CO5	**3**	**2**	**3**	**1**

3. Advanced Application 2. Intermediate Development 1. Introductory Level

COURSE CODE	COURSE TITLE	CATEGORY	T	P	CREDITS
24PMBE23	MEDICAL VIROLOGY AND PARASITOLOGY	ELECTIVE – 2	4	–	3

YEAR	SEMESTER	INTERNAL	EXTERNAL	TOTAL
I	II	25	75	100

NATURE OF COURSE	Employability		Skill Oriented	✓	Entrepreneurship	

COURSE DESCRIPTION:

This course is divided into three sections: Virology, Parasitology and Mycology. Each section centers on the approach used in clinical microbiology laboratories to isolate and identify pathogens of significance from human specimens. In addition, each section gives an extensive overview of clinical infections with emphasis on the major pathogens recovered from clinical specimens.

COURSE OBJECTIVES:

- To publicize the students with working knowledge of techniques used to identify infectious agents in the clinical microbiology lab.
- To acquaint the students, explain viruses, fungi and parasites including their classification, morphology, and laboratory diagnosis and prevention measures
- To make the students perform laboratory investigations for the diagnosis of infectious diseases caused by viruses, fungi and parasites
- To expose students to various viral fungal and parasitic diseases of human.

COURSE OUTCOMES (COs):

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

No.	Course Outcomes	Knowledge Level (According to Bloom's Taxonomy)
CO 1	To understand the general characteristics and pathobiology of different classes of viruses.	Upto K5
CO 2	To learn lab diagnosis, prophylaxis and treatment of DNA viral disease	Upto K5
CO 3	Gain knowledge about diagnosis, prophylaxis and treatment of RNA viral disease	Upto K5
CO 4	To learn emerging viral infections and antiviral agent	Upto K5
CO 5	Understand general features and classification of medically important protozoans	Upto K5

K1–KNOWLEDGE (REMEMBERING), K2–UNDERSTANDING, K3–APPLY, K4–ANALYSE, K5–EVALUATE

MEDICAL VIROLOGY AND PARASITOLOGY

UNIT – I

General outline on viral infection, Classification of medically important RNA, DNA viruses, Virus cultivation, Zoonotic viral diseases – (Rabies, hantaviruses, Arenaviruses, yellow fever virus, chikungunya virus, reservoirs and transimission – brief)

UNIT – II

General properties, clinical importance, pathogenesis and laboratory diagnosis of diseases caused by DNA viruses – Pox – , Varicola, Vaccinia, Herpes – Varicella Zoster, Herpes Zozter, Adeno, Papova (brief note) and Parvoviruses.

UNIT – III

General properties, clinical importance, pathogenesis and laboratory diagnosis of diseases caused by RNA Viruses – common cold, influenza, SARS, MERS, COVID – 19, Dengue virus, hepatitis C and E, West Nile fever, Ebola virus, Rabies, polio, mumps, measles and HIV, NorovirusHepatitis A and E, Rotavirus.

UNIT – IV

Viruses and cancer – Viruses implicated in the cancers of humans (HTL virus, Hepatitis B, Hepatitis C, papilloma virus, Epstein Barr Virus, human herpes virus 8), Slow virus infections, Prion diseases, Emerging viral infections – Nippah, Zikka, HINI, Swine flu, Avian flu. Prophylaxis of viral diseases – Immunological, Chemotheraphy, antiviral agents. Mechanisms of action Interferons.

UNIT – V

Protozoa – General features and classification. Medically important protozoans. *Entamoebahistolytica*, *Giardia lamblia*, *Trichomonas*, Trypanosomes, Leishmania, Plasmodium, Toxoplasma and Pneumocystis.

TEXT BOOKS:

1. Molyneux, D.H., and Ashford, R.W.(1983). ***The biology of Trypanosoma and Leishmania, parasites of man and domestic animals (***New York, International Publications Service)
2. Garraway, M.O., and Evans, R.C. (1991). ***Fungal nutrition and physiology*** (Malabar, FL, Krieger Pub.Co.).
3. Fields, B.N., Knipe, D.M., and Howley, P.M. (2007). *Fields virology*, 5th edn (Philadelphia, Wolters Kluwer Health/Lippincott Williams &Wilkins)
4. Fraenkel – Conrat, H., and Wagner, R.R. (1974). *Comprehensive virology* (New York, Plenum Press).
5. Sood R. 2009. ***Medical Laboratory Technology – Methods and Interpretations***. (6th Edition). Jaypee Brothers Medical Publishers (P) Ltd. New Delhi. ISBN:9788184484496.

REFERENCE BOOKS:

1. Murray P. R., Baron E. J., Jorgenson J. H., Pfaller M. A. and Yolken R.H. (2003). ***Manual of Clinical Microbiology***. (8th Edition). American Society for Microbiology, Washington, DC. ISBN:1 – 555810255 – 4.
2. Bennett J. E., Dolin R. and Blaser M. J. (2019). **Principles and Practice of Infectious Diseases.** (9th Edition). Elsevier. EBook ISBN:9780323550277. Hardcover ISBN:9780323482554.
3. Ridgway G. L., Stokes E. J. and Wren M. W. D. (1987). ***Clinical Microbiology*** 7th Edition. Hodder Arnold Publication. ISBN – 10:0340554231 / ISBN – 13:9780340554234.
4. Parija, S.C., (2023). ***Textbook of microbiology and immunology***. Springer.
5. Goering, R., Dockrell, H.M., Zuckerman, M. and Chiodini, P.L., (2023). ***Mims' Medical Microbiology E – Book***. Elsevier Health Sciences.

DIGITAL TOOLS:

1. https://www.ncbi.nlm.nih.gov/books/NBK20370/
2. https://www.msdmanuals.com/en – in/home/infections/diagnosis – of – infectious3disease/diagnosis – of – infectious – disease
3. https://journals.asm.org/doi/10.1128/JCM.02592 – 20
4. https://www.sciencedirect.com/science/article/pii/S2221169116309509
5. http://www.textbookofbacteriology.net/normalflora_3.html

Mapping of CO with PSO

	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2
CO2	2	3	1	3
CO3	3	3	2	1
CO4	2	1	3	2
CO5	1	3	2	3

3. Advanced Application 2. Intermediate Development 1. Introductory Level