Syllabus of 4 + 1 Year Integrated UG and PG Programme

w. e. f 2024-25 Academic Year

GRADUATE SCHOOL

Mahatma Gandhi University

P. D. Hills P O

Kottayam, Kerala

www.gs.mgu.ac.in

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Schools offering Majors

SL.No	School/Centre
1	School of Bio Sciences
2	School of Chemical Sciences
3	School of Computer Sciences
4	School of Environmental Sciences
5	School of Gandhian Thought and Development Studies
6	School of International Relations and Politics
7	School of Pure and Applied Physics
8	School of Social Sciences

Sl. No.	Major	Intake
SCIENCE		
1	Bio Sciences	6**
2	Chemistry	6
3	Computer Science	6
4	Environmental Science	6
5	Physics	6
SOCIAL SCIENCES		
1	Development Studies	5
2	Gandhian Studies	5
3	History	10
4	International Relations and Politics	10

Majors offered and Intake *1 seat shall be sanctioned over and above the intake in each major in the 3rd semester for students who opt for a change of major after two semesters.

**Progression to PG Shall be based on the specialization selected by students as Biochemistry (2 seats) Biotechnology (2 seats) and Microbiology (2 seats) based on merit.

Schools offering Minors/MDCs/AECs/VACs/SECs

SL.No	School/Centre
1	School of Artificial Intelligence And Robotics
2	School of Behavioural Sciences
3	School of Biosciences
4	School of Chemical Sciences
5	School of Computer Sciences
6	School of Data Analytics
7	School of Energy Materials
8	School of Environmental Sciences
9	School of Food Science And Technology
10	School of Gandhian Thought And Development Studies
11	School of Gender Studies
12	School of Indian Legal Thought
13	School of International Relations And Politics
14	School of Letters
15	School of Mathematics And Statistics
16	School of Nanoscience And Nano Technology
17	School of Pedagogical Sciences
18	School of Polymer Science And Technology
19	School of Pure And Applied Physics
20	School of Social Sciences
21	School of Tourism Studies
22	International and Inter University Centre for Nanoscience and Nanotechnology
23	K N Raj School of Economics

Scheme for 4 + 1 Integrated UG and PG Programme
Graduate School
Mahatma Gandhi University
School of Computer Sciences

Course Code	Title	Credits	Hours per Week		Level	Type
			Theory	Practicals		
SEMESTER I						
MG1DSCUCO101	Digital Fundamentals	4	4	0	Foundation (100-199)	Major
MG1DSCUCS121	Digital Fundamentals	4	4	0	"	Minor A
MG1DSCUCS141	Problem Solving and Fundamentals of Programming	4	2	4	"	Minor B
MG1MDCUCS101	Foundations of Data Organization	3	2	2	"	MDC
	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER II						
MG2DSCUCO101	Problem Solving and Fundamentals of Programming	4	2	4	"	Major
MG2DSCUCS121	Object Oriented Programming using JAVA	4	2	4	"	Minor A
MG2DSCUCS141	Algorithms and Problem Solving	4	3	2	"	Minor B
MG2MDCUCS101	Data Processing Techniques	3	2	2	"	MDC

	AEC (Eng)	3			“	
	AEC (Mal)	3			“	
SEMESTER III						
MG3DSCUCO201	Computer Organization and Architecture	4	4	0	Intermediate (200-299)	Major
MG3DSCUCO202	Data Communication	4	4	0	“	Major
MG3DSCUCO203	Data Structures	4	2	4	“	Major
MG3DSCUCS221	Database Management Systems	4	2	4	“	Minor A
MG3MDCUCS201	Computational Intelligence - AI in Problem Solving	3	2	2	“	MDC
MG3VACUCS201	Security & Ethics in Cyber World	3	3	0	“	VAC
SEMESTER IV						
MG4DSCUCO201	Operating Systems	4	4	0	“	Major
MG4DSCUCO202	Object Oriented Programming using Java	4	2	4	“	Major
MG4DSCUCO203	Microprocessors	4	2	4	“	Major
MG4DSCUCS241	Software Engineering	4	4	0	“	Minor B

MG4SECUCS201	Web Technologies	3	2	2	“	SEC
MG4VACUCS201	Green Computing	3	3	0	“	VAC
MG4INTUCO200	Internship/Fieldwork	2	0	4		
SEMESTER V						
MG5DSCUCO301	Database Management Systems	4	2	4	Higher (300-399)	Major
MG5DSCUCO302	Design and Analysis of Algorithms	4	3	2	“	Major
MG5DSCUCO303	Computer Networks	4	4	0	“	Major
MG5DSCUCO304	Machine Learning	4			“	Major
MG5SECUCS301	Search Engine Optimization	3	2	2	“	SEC
MG5VACUCS301	Publication Ethics	3	3	0	“	VAC
SEMESTER VI						
MG6DSCUCO301	Software Engineering	4	4	0	“	Major
MG6DSCUCO302	Advanced Java	4	2	4	“	Major

	Programming					
MG6DSCUCO303	Theory of Computation	4	4	0	“	Major
MG6DSEUCO304 MG6DSEUCO305 MG6DSEUCO306	1. Data Mining 2. IoT and Robotics 3. Introduction to Data Science	4	2	4	“	Major (E)
MG6DSEUCO307 MG6DSEUCO308 MG6DSEUCO309	1. Mobile Development Technologies 2. Big Data Analytics 3. Cloud Computing	4	2	4	“	Major (E)
MG6SECUCS301	Software Project Management: Case Study	3	1	4	“	SEC
Total Credits		**133**				

SEMESTER VII						
MG7DSCUCO401	Deep Learning	4	2	4	Advanced (400-499)	Major
MG7DSEUCO402 MG7DSEUCO403	1 Digital Image Processing 2 Advanced Computer Architecture and Parallel Programming	4	2	4	“	Major (E)

MG7DSEUCO404	3 Artificial Intelligence					
MG7DSEUCO405 MG7DSEUCO406 MG7DSEUCO407	1 Advanced Data Structures 2 Cyber Security and Cyber Laws 3 Graphics and Visualization	4	2	4	"	Major (E)
MG7DSCUCS421	Research Methodology & Ethics	4	4	0	"	Minor A
MG7DSEUCS422 MG7DSEUCS423 MG7DSEUCS424	1 Explainable AI 2 Digital Forensics 3 Cryptography	4	3	2	"	Minor A(E)
MG7DSEUCS441 MG7DSEUCS442 MG7DSEUCS443	1 Compiler Design 2 Data Analytics using R 3 Blockchain Technologies	4	3	2	"	Minor B(E)
SEMESTER VIII						
MG8DSCUCO401	Research Methodology & Ethics	4	4	0	"	Major
MG8DSEUCO402 MG8DSEUCO403	1 Algorithms and Complexity 2 Cyber Physical Systems 3 Operating Systems and Virtualization	4	3	2	"	Major (E)

MG8DSEUCO404						
MG8RPHUCO400	Research Project I	12	0	24	“	Research Project
Total Credits		**44**				
SEMESTER IX						
MG09DSCUCO501	Computer Vision	4	2	4	PG Level (500-599)	Major
MG09DSCUCO502	Wireless Communication and Sensor Networks	4	4	0	“	Major
MG09DSCUCO503	Natural Language Processing	4	2	4	“	Major
MG09DSEUCO504 MG09DSEUCO505 MG09DSEUCO506	1 Data Science 2 Fuzzy Logic and Nature Inspired Computing 3 Digital Signal Processing and Speech Technologies	4	2	4	“	Major (E)
MG09DSEUCO507 MG09DSEUCO508 MG09DSEUCO509	1 Generative AI 2 Bioinformatics 3 Blockchain Technologies	4	3	2	“	Major (E)
SEMESTER X						
MG10RPHUCO500	Research Project	20	0	40	“	
	Major**	4			“	
	Major**	4			“	

	Major**	4			“	
	Major**	4			“	
	Major**	4			“	
Total Credits		**40**				

**Only for students who opt for theory courses instead of Research Project

Note: General foundations courses shall be offered by different schools. Students can flexibly choose the courses across disciplines.

Level	Foundation (100-199)	Intermediate (200-299)	Higher (300-399)	Advanced (400-499)	PG Level (500-599)

Type	Major	Minor	MDC	SEC	VAC	AEC

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Digital Fundamentals		
Course Type	Major		
Course Level	100-199		
Course Code	MG1DSCUCO101		
Course Overview	This course provides the basic concepts of number systems, Boolean algebra and digital systems. It covers the design of simple combinational and sequential logic circuits which in turn are helpful in understanding organization & design of a computer system.		
Semester	I	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Basic knowledge of electronics and number systems at plus two level.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Perform operations and conversions among different number systems.	R, U	1, 2
2	Apply the basic concepts of Boolean algebra for the simplification and implementation of logic functions using suitable gates.	U, A	1, 2
3	Design simple combinational circuits.	A, E, C	1, 2, 3, 4
4	Design sequential circuits.	A, E, C	1, 2, 3, 4
5	Implement PLDs for the given logical problem.	A, An, C	1, 2, 3, 5, 6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No.
Number Systems: Number Systems- Basic Concepts, Conversions and Operations, Representation of Negative Numbers- Complements and their Applications, BCD Numbers- Concept and Addition, Other Binary Codes, Error Detection Codes.	13	1
Module 2	**Hours**	
Logic Gates and Boolean Algebra: Logic Gates- Basic and Universal Gates, Truth Table, Graphical	15	2

Representation, Basic Theorems and Properties of Boolean Algebra, Boolean Functions - Canonical and Standard Forms, Simplification of Boolean Functions - SOP and POS Minimization, Karnaugh Map Simplification.		
Module 3	**Hours**	
Sequential and Combinational Logic Circuits: Binary Adder and Subtractor, Magnitude Comparator, Decoder, Encoder, Code Converters, Demultiplexer, Multiplexer, Parity Generator and Checker. Flip-flops- Latch, Clocked, RS, JK, T, D and Master Slave.	15	3, 4
Module 4	**Hours**	
Registers and Counters: Register, Shift Registers, Asynchronous Counters- Binary and BCD Ripple Counters, Synchronous Counters- Binary Counter, Binary Up- Down Counter, BCD Counter, Johnson Counter. **Memory and Programmable Logic Devices:** RAM, ROM, Programmable Logic Arrays (PLA), Programmable Array Logic (PAL).	17	4, 5

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative. **Field activities:** Understand the working principles of computer hardware
Mode of Assessment	**A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum Two (Extended answers / Practical) ● Seminar ● Assignment – Written, Practical, Oral Presentation and Viva

	● Case study/ Mini project **B. Semester End Examination**

Learning Resources

1. M. Morris Mano, Digital Logic and Computer Design, 6/e, Pearson Education India, 2023.

2. Thomas L Floyd, Digital Fundamentals, 11/e, Pearson Education, 2017.

3. M. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2017.

Relevance of Learning the Course/ Employability of the Course
Digital electronics is foundational to modern computing, providing essential insights into how computers process and store information. It explains how software instructions are executed by underlying hardware. This knowledge is vital for embedded systems, designing CPUs, memory, and I/O systems. Furthermore, studying digital electronics is crucial for hardware related applications in computer science and technology-driven industries.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Digital Fundamentals		
Course Type	Minor		
Course Level	100-199		
Course Code	MG1DSCUCS121		
Course Overview	This course provides the basic concepts of number systems, Boolean algebra and digital systems. It covers the design of simple combinational and sequential logic circuits which in turn are helpful in understanding organization & design of a computer system.		
Semester	I	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Basic knowledge of electronics and number systems at plus two level.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Perform operations and conversions among different number systems.	R, U	1, 2
2	Apply the basic concepts of Boolean algebra for the simplification and implementation of logic functions using suitable gates.	U, A	1, 2
3	Design simple combinational circuits.	A, E, C	1, 2, 3, 4
4	Design sequential circuits.	A, E, C	1, 2, 3, 4
5	Implement PLDs for the given logical problem.	A, An, C	1, 2, 3, 5, 6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No.
Number Systems: Number Systems- Basic Concepts, Conversions and Operations, Representation of Negative Numbers- Complements and their Applications, BCD Numbers- Concept and Addition, Other Binary Codes, Error Detection Codes.	13	1
Module 2	**Hours**	
Logic Gates and Boolean Algebra: Logic Gates- Basic and Universal Gates, Truth Table, Graphical	15	2

Representation, Basic Theorems and Properties of Boolean Algebra, Boolean Functions - Canonical and Standard Forms, Simplification of Boolean Functions - SOP and POS Minimization, Karnaugh Map Simplification.		
Module 3	**Hours**	
Sequential and Combinational Logic Circuits: Binary Adder and Subtractor, Magnitude Comparator, Decoder, Encoder, Code Converters, Demultiplexer, Multiplexer, Parity Generator and Checker. Flip-flops- Latch, Clocked, RS, JK, T, D and Master Slave.	15	3, 4
Module 4	**Hours**	
Registers and Counters: Register, Shift Registers, Asynchronous Counters- Binary and BCD Ripple Counters, Synchronous Counters- Binary Counter, Binary Up- Down Counter, BCD Counter, Johnson Counter. **Memory and Programmable Logic Devices:** RAM, ROM, Programmable Logic Arrays (PLA), Programmable Array Logic (PAL).	17	4, 5

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative. **Field activities:** Understand the working principles of computer hardware
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	● Case study/ Mini project **B. Semester End Examination**

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	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Problem Solving and Fundamentals of Programming		
Course Type	Minor		
Course Level	100-199		
Course Code	MG1DSCUCS141		
Course Overview	This course covers programming concepts including pointers, dynamic memory allocation, linked lists, and file handling using the C language, with a focus on efficient, low-level programming techniques. It also explores best practices in code organization, modular programming, and software development. Mastery of C provides a solid foundation for learning other programming languages and deepens understanding of core computer science principles.		
Semester	I	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	40	40	
Pre-requisite	Basic knowledge about the Computers		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Analyse computational problems and develop algorithms/flowcharts to find the solutions.	A, An	1
2	Develop C programs using functions.	S, C	1,2
3	Implement C programs with arrays, strings, structure or union.	A, C	3,4
4	Develop C programs using pointers and files.	A, C, S	1,5,6
5	Handle system level programming in C.	A, S	2,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Introduction to programming: Problem Solving Techniques, Types of Programming Languages and Translators, Introduction to C Programming, Operators and Expressions, Control Flow Statements, Looping Statements.	8	1
Module 2	**Hours**	
Functions: Predefined Functions, Programmer-defined Function, Functions with Default Arguments, Call-By-Value and Call-By-Reference Parameters, Recursion	16	2
Module 3	**Hours**	
Arrays: Single and Multi-Dimensional Arrays, Arrays as Function Parameters,	16	3

Structures: Member Accessing, Pointers to Structures, Arrays of Structures, Unions. **Strings:** Arrays of Strings, String and Function, Strings and Structure, Standard String Library Functions**.**		
Module 4	**Hours**	
Pointers: Array Access using Pointers, Pass by Reference Effect, Strings and Pointers **Files:** File Operations, Read, Write, Append Contents to a File, Sequential and Random Search of Contents, Merging and Copying Files, Dynamic Memory Allocation and Linked Lists, Low-level Programming.	20	4, 5

Mode of Transaction	**Classroom activities** • Lecturing, Discussions, Writing Programs **Field activities** **Lab based activities** • Implement programs
Mode of Assessment	A. Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Practical, Oral Presentation and Viva B. Semester End Examination

Learning Resources

1. *Brian W Kernighan & Dennis Ritchie, "The C programming language", 2nd Edition, Prentice Hall*

2. *Stephen Prata, C Primer Plus, 6th Edition, Addison-Wesley Professional.*

3. *Jens Gustedt, Modern C, Manning Publications.*

Relevance of Learning the Course/ Employability of the Course
C programming language holds immense importance in the software development industry. Its simplicity, efficiency, and versatility make it a powerful tool for developing a wide range of applications. C is utilized across various domains, from operating systems to embedded systems. Learning C opens up a world of possibilities for aspiring programmers and enables them to contribute to the

ever-evolving field of technology.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Foundations of Data Organization		
Course Type	MDC		
Course Level	100-199		
Course Code	MG1MDCUCS101		
Course Overview	Proper data organization is crucial for effective data processing, retrieval, analysis, and decision-making. This course covers key concepts and techniques in data organization which includes methods and processes used to structure, store, manage, and utilize data efficiently.		
Semester	1	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	35	20	
Pre-requisite	General understanding of computers.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Understand various data organizations and models which use different data representations and illustrate data management, storage efficiency and storage capacities.	R, U	1
2	Apply master data indexing, partitioning, normalization, denormalization, cataloging, archiving, security, and backup/recovery for data organization process.	A	2
3	Illustrate big data fundamentals, manipulate data using Hadoop, implement data security techniques and analyse emerging data organization trends.	U, An, S	4,5
4	Design and develop data organization mechanisms to represent real world data.	E, C	3,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Introduction: Data Organization, Data Structuring, Hierarchical Organization, Network Model, Relational Model, Data Storage, Databases, Data Warehouses, Data Lakes.	**15**	**1**

Module 2	**Hours**	
Data Management: Data Indexing, Data Partitioning, Data Normalization, Data Denormalization, Data Cataloging, Data Archiving, Data Security, Data Backup and Recovery.	**20**	**2**
Module 3	**Hours**	
Big Data Fundamentals: Hadoop, Data Security and Privacy, Data Encryption, Review of Modern Data Organization Tools, Emerging Trends in Data Organization.	**20**	**3, 4**

Mode of Transaction	**Classroom activities:** Lecture and Tutorial **Field activities:** Collect Primary data from the source **Lab based activities:** Data Management Activities and Tools
Mode of Assessment	A. Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Practical, Oral Presentation and Viva B. End Semester Examination

Learning Resources

1. Jiawei Han, Jian Pei, and Hanghang Tong. Data Mining: Concepts and Techniques. Fourth Edition, Elsevier, 2024.
2. Narasimha Karumanchi. Data Structures and Algorithms Made Easy. CareerMonk Publications, 6th Edition, 2022.
3. Silberschatz, Korth, and Sudarshan. Database System Concepts. McGraw-Hill Education, 7th Edition, 2020.
4. Tom White. Hadoop: The Definitive Guide. Fourth Edition, O'Reilly Media, 2015.

Relevance of Learning the Course/ Employability of the Course
Learning data organization enhances employability by equipping students with skills in data processing, retrieval and analysis. These skills are essential for roles in data analysis and management across diverse IT industries.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Problem Solving and Fundamentals of Programming		
Course Type	Major		
Course Level	100-199		
Course Code	MG2DSCUCO101		
Course Overview	This course covers programming concepts including pointers, dynamic memory allocation, linked lists, and file handling using the C language, with a focus on efficient, low-level programming techniques. It also explores best practices in code organization, modular programming, and software development. Mastery of C provides a solid foundation for learning other programming languages and deepens understanding of core computer science principles.		
Semester	I	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	40	40	
Pre-requisite	Basic knowledge about the Computers		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Analyse computational problems and develop algorithms/flowcharts to find the solutions.	A, An	1
2	Develop C programs using functions.	S, C	1,2
3	Implement C programs with arrays, strings, structure or union.	A, C	3,4
4	Develop C programs using pointers and files.	A, C, S	1,5,6
5	Handle system level programming in C.	A, S	2,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Introduction to programming: Problem Solving Techniques, Types of Programming Languages and Translators, Introduction to C Programming, Operators and Expressions, Control Flow Statements, Looping Statements.	8	1
Module 2	**Hours**	
Functions: Predefined Functions, Programmer-defined Function, Functions with Default Arguments, Call-By-Value and Call-By-Reference Parameters, Recursion	16	2
Module 3	**Hours**	
Arrays: Single and Multi-Dimensional Arrays, Arrays as Function Parameters,	16	3

Structures: Member Accessing, Pointers to Structures, Arrays of Structures, Unions. **Strings:** Arrays of Strings, String and Function, Strings and Structure, Standard String Library Functions**.**		
Module 4	**Hours**	
Pointers: Array Access using Pointers, Pass by Reference Effect, Strings and Pointers **Files:** File Operations, Read, Write, Append Contents to a File, Sequential and Random Search of Contents, Merging and Copying Files, Dynamic Memory Allocation and Linked Lists, Low-level Programming.	20	4, 5

Mode of Transaction	**Classroom activities** • Lecturing, Discussions, Writing Programs **Field activities** **Lab based activities** • Implement programs
Mode of Assessment	A. Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Practical, Oral Presentation and Viva B. Semester End Examination

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ever-evolving field of technology.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Object Oriented Programming using JAVA		
Course Type	Minor		
Course Level	100-199		
Course Code	MG2DSCUCS121		
Course Overview	This course helps to create in-depth knowledge in object oriented programming concepts and to develop programming language skills. The students are exposed to the core and advanced features available in Java, such as file handling, interfaces, packages and GUI programming. Mastery of Java ensures a solid foundation for modern software development.		
Semester	II	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	40	40	
Pre-requisite	Basic programming knowledge.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		

1	Understand object oriented programming concepts for implementing classes, objects and the relationships among them using Java.	R,U	1, 2
2	Implement efficient programs in Java by applying object oriented features.	A,S	1, 2, 3
3	Analyse common abstract user interface components and design GUI using Applet & AWT along with response to events.	An, C, S	1, 2, 4
4	Evaluate the connection of interface and database with the help of JDBC.	E,S	1, 5
5	Design and develop complex Graphical user interfaces.	C,S	5, 6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Introduction: Object Oriented Programming, Comparison between Procedural and Object Oriented Programming, Basic Principles of Object Orientation, Introduction to Java: Java Virtual Machine, Java Program Language Components.	10	1
Module 2	**Hours**	
I/O, Threads and Exception Handling: Introduction to Classes and Methods, Input and Output, File Class, **Threads:** Threads vs. Processes, Creating Threads, Synchronization. **Exceptions:** Exception Handling, Developing User Defined Exception Classes.	10	2
Module 3	**Hours**	
Database Connectivity & GUI: Introduction to JDBC : The JDBC Connectivity Model, Database Programming, Connecting to the Database, Creating a SQL Query. **Introduction to GUI Applications** - Applets - Types of Applet, Applet Skeleton, HTML Applet Tag and Passing Parameter to Applet.	10	3, 4
Module 4	**Hours**	
Events and GUI Applications: Event Handling: The	10	5

Delegation Event Model, Event Classes, Event Listener Interfaces, Adapter Classes. Java Desktop Applications, Introduction to the AWT, Containers, Components, Canvas, Frame Working Attributes, Simple Graphics, Controls.		

Mode of Transaction	**Classroom activities:** ● Lecturing, Discussions, Writing Programs ● Seminar and Assignment **Field activities:** **Lab based activities:** • Implement each topic in lab to learn the logic behind it.
Mode of Assessment	• Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Practical, Oral Presentation and Viva • Semester End Examination

Learning Resources

1. Schildt, H. (2023). Java: The Complete Reference. 13th edition. McGraw-Hill Education.

2. Balaguruswamy E. (2023). Programming with JAVA. 7th edition. India: McGraw Hill Education

3. Horstmann, C. S. (2017). Core Java - Vol. I – Fundamentals (Vol. 10). Pearson Education

4. Mark Reed(2020) Java : The ultimate beginners guide to effectively learn java programming step-by-step, Publishing Factory LLC.

Relevance of Learning the Course/ Employability of the Course

Learning Object Oriented Programming in Java is crucial as it forms the foundation for advanced Java technologies and frameworks, enhancing employability in the software development industry. Core Java skills are in high

demand due to the widespread use of Java in enterprise applications, Android development, and web services. Proficiency in Java improves job prospects, enabling roles such as software engineer, backend developer, and systems architect.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Algorithms and Problem Solving		
Course Type	Minor		
Course Level	100-199		
Course Code	MG2DSCUCS141		
Course Overview	This course will introduce students to the fundamental concepts of algorithms and problem-solving techniques. Students will learn to design, analyze, and implement algorithms to solve real-world problems efficiently.		
Semester	II	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	50	20	
Prerequisite	Basic Problem solving skill and mathematical foundation.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Recall fundamental concepts of algorithms and data structures.	R	1
2	Explain the importance and applications of algorithms in problem-solving.	U	2
3	Apply basic data structures and efficient design strategies to implement algorithms and solve problems.	A	3,5
4	Design efficient algorithms to solve real-world problems and evaluate the efficiency and correctness of the solutions.	C, E	4,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No.**
Introduction: Algorithms, Importance of Algorithms in Problem Solving, Basic Algorithmic Concepts, Performance Analysis	**15**	**1**
Module 2	**Hours**	
Problem Solving Strategies: Understanding Problem Constraints, Breaking Down Problems, Problem-Solving Patterns.	**15**	**2**
Module 3	**Hours**	
Basic Data Structures and Algorithm Design Strategies: Arrays and Lists, Stacks and Queues, Linked Lists. **Introduction to Algorithm Design Strategies**: Divide and Conquer, Greedy, Dynamic Programming, Backtracking.	**20**	**3**
Module 4	**Hours**	
Searching and Sorting Algorithms: Linear Search,	**20**	**4**

Binary Search, Search Efficiency, Depth-First Search (DFS), Breadth-First Search (BFS), **Sorting Algorithms:** Bubble Sort, Selection Sort, Insertion Sort, Merge Sort and Quick Sort.		

Mode of Transaction	**Classroom activities** • Lecturing, Discussions, Writing Programs **Field activities** **Lab based activities:** Problem solving activities
Mode of Assessment	A. Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Practical, Oral Presentation and Viva B. Semester End Examination

Learning Resources

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to Algorithms. (MIT Press, 3rd Edition, 2009)
2. Robert Sedgewick and Kevin Wayne. Algorithms. (Addison-Wesley Professional, 4th Edition, 2011)
3. Steven S. Skiena. The Algorithm Design Manual. (Springer, 2nd Edition, 2008)

Relevance of Learning the Course/ Employability of the Course
Learning algorithms and problem-solving is crucial for a career in software development, data science, and computer engineering. This course equips students with essential skills to analyze complex problems, design efficient algorithms, and implement effective solutions.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	Computer Science		
Course Title	Data Processing Techniques		
Course Type	MDC		
Course Level	100-199		
Course Code	MG2MDCUCS101		
Course Overview	This course covers essential data processing techniques, including data collection, cleaning, transformation, aggregation, and integration. Students will gain hands-on experience with descriptive and inferential statistical methods, and apply best practices in real-world scenarios.		
Semester	II	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	35	20	
Prerequisite	Basic computing skills and fundamental statistics.		

COURSE OUTCOMES (CO)

CO	Expected Course Outcome	Learning	PSO

No.	*Upon completion of this course, students will be able to;*	Domains	No.
1	Classify various data types, storage, retrieval, modeling, and security of data.	R, U	1
2	Create quality data using advanced techniques.	An, C	2, 3
3	Formulate various data models using EDA techniques, descriptive and inferential statistics, and data visualization methods.	U, An	4, 5
4	Design and assess various data models.	C, E	2, 6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Introduction: Data, Types of Data, Characteristics of Data, Data Storage and Retrieval, Data Modeling, Data Security, Data Collection, Data Sampling, Sampling Techniques, Sampling Design, Data Filtering, Data Management.	**15**	**1**
Module 2	**Hours**	
Data Processing Techniques: Data Cleaning, Handling Missing Values, Data Integration, Data Transformation, Data Normalization, Data Reduction- Dimensionality Reduction Methods.	**20**	**2**
Module 3	**Hours**	
Data Analysis Techniques: Introduction to Exploratory Data Analysis (EDA), Descriptive Statistics, Inferential Statistics, Data Visualization Techniques.	**20**	**3, 4**

Mode of Transaction	**Classroom activities:** Lecture and Tutorial **Field activities:** Collect Primary data from the source **Lab based activities:** Data processing activities
Mode of Assessment	A. Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Practical, Oral Presentation and Viva

	B. End Semester Examination

Learning Resources

1. **Salvador García, et al.** Data Preprocessing in Data Mining. Springer International Publishing, Germany, 2014.
2. **Foster Provost and Tom Fawcett.** Data Science for Business. O'Reilly Media, 2013.
3. **C.R. Kothari.** Research Methodology: Methods and Techniques. New Age International, 2nd Edition, 2004.
4. **Jiawei Han, Jian Pei, and Hanghang Tong.** Data Mining: Concepts and Techniques. Fourth Edition, Elsevier, 2024.

Relevance of Learning the Course/ Employability of the Course
Mastering data processing techniques is crucial for careers in data science, analytics, and information technology. This course equips students with skills in data processing essentially required in data-driven industries.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Computer Organization and Architecture		
Course Type	Major		
Course Level	200-299		
Course Code	MG3DSCUCO201		
Course Overview	This course introduces the principles of computer organization and the basic architecture concepts. It describes the internal workings of computers, providing an understanding of how computer hardware and software interact to execute tasks. It covers the principles and practices of computer architecture, including the structure, functionality, and performance of computer systems.		
Semester	III	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	• Basic knowledge of programming concepts. • Familiarity with binary numbers and basic algebra.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Illustrate the structure and functionality of computer systems.	R, U	5
2	Analyze the effect of addressing modes on the execution time of a program.	U, A, An	1,2
3	Describe the components of an instruction set architecture.	A, C	1,3,6
4	Evaluate the performance and efficiency of various memory organizations and architectures. Understand the mechanisms of input/output systems.	U, E	1,3
5	Document, present, and demonstrate concepts of computer organization and architecture, including system architecture, data path design, control units, memory organization, and input-output systems in a clear and effective manner, utilizing appropriate tools and simulations.	R, U, A, E	1,2,3, 4,5,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No.
Basic Computer Organization and Design: Operational Concepts, Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory Reference Instructions, Input - Output and Interrupt, Bus Organization, Complete Computer Description, Design of Basic Computer.	15	1,5
Module 2	**Hours**	
Processor and Control Unit: Hardwired Vs. Micro Programmed Control Unit, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation Instructions, Program Control.	16	2, 3,5
Module 3	**Hours**	
Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Performance Considerations, Virtual Memory, Memory Management, Secondary Storage.	15	4,5

Module 4	Hours	
Input-output organization: Accessing I/O Devices, Interrupts, Direct Memory Access, Buses, Interface Circuits, I/O Interfaces, Data Transfer Schemes. Case studies on modern architectures (e.g., ARM Cortex, AMD Ryzen, Intel Xeon)	14	4,5

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative. **Field activities:** Understand large-scale memory management, data storage solutions, and high-performance computing environments.
Mode of Assessment	**A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum Two ● Seminar ● Assignment – Written, Oral Presentation and Viva ● Case study/ Mini project **B. Semester End Examination**

Learning Resources

1. M. Morris Mano, Computer Systems Architecture, Revised Third Edition, Pearson Education.

2. Carl Hamacher, Computer Organization, Fifth Edition, Tata McGraw Hill.

3. John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Sixth Edition, Morgan Kaufmann Publishers.

Relevance of Learning the Course/ Employability of the Course
Knowledge of computer architecture helps software developers write more efficient code, optimize applications, and better understand system constraints. Professionals involved in designing new computing systems, such as embedded systems or IoT devices, benefit significantly from understanding how different components work together. This course provides the groundwork for research in areas like parallel processing, quantum computing, and advanced processor designs.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Data Communication		
Course Type	Major		
Course Level	200-299		
Course Code	MG3DSCUCO202		
Course Overview	The course starts with the fundamentals of data communication, including the history and evolution of networking, and the basics of signal transmission over different media like cables and wireless channels. This course covers key concepts such as the basics of networking, types of data transmission, and error detection and correction methods.		
Semester	III	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Basic knowledge about the Computers.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Understand Network Models	U	1,6
2	Describe the fundamentals of digital Transmission	U, A	2
3	Analyse Multiplexing and Switching	An	4
4	Compare and contrast data link layer protocols and networking devices	E, A, An	2,6
5	Document, present and demonstrate the networking concepts and protocols with the help of appropriate aids	E, A, An	6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Introduction: Data Communications, Networks, Network Types, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Data and Signals, Digital Signals, Transmission Impairment, Data Rate Limits, Performance.	15	1,5
Module 2	**Hours**	
Digital Transmission: Digital to Digital Conversion, Analog to Digital Conversion, Transmission Modes, Digital to Analog Conversion, DTE-DCE Interface, Modems, Cable Modems, Transmission Media: Guided Media, Unguided Media.	15	2
Module 3	**Hours**	
Multiplexing and Switching: Bandwidth Utilization, Multiplexing and Spread Spectrum, Multiplexing	15	3,5

Applications, Switching: Circuit Switching and Packet Switching, Integrated Services Digital Networks (ISDN), Error Detection and Correction: Block Coding, Cyclic Codes, Checksum		
Module 4	**Hours**	
Data Link Control: Data Link Layer Protocols, Media Access Control: Random Access, Controlled Access and Channelization, Link-Layer Addressing, ARP, Ethernet LANs; Connecting LAN and Back -Bone Networks- Repeaters, Hubs, Switches, Bridges, Router and Gateways, Wireless LANs, Recent Developments in Data Communication and Networking	15	4,5

Mode of Transaction	**Classroom activities** • Direct Instruction: Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments • Authentic learning: Library work and Group discussion, Presentation by individual student/Group representative.
Mode of Assessment	A. Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Oral Presentation and Viva B. Semester End Examination

Learning Resources

1. Behrouz A. Forouzan, Data Communication and Networking, 6th edition, TMH Publishing Company Ltd.
2. William Stallings, Data and Computer Communications, 10th Ed, Pearson Education.
3. William L. Schweber- Data Communications, 1st edition, Tata McGraw Hill Publishing Co. Ltd.

Relevance of Learning the Course/ Employability of the Course
Learning data communication is highly relevant in today's digital age. It equips individuals with the necessary skills to manage and secure data networks, which are essential for various technological advancements and industries. The knowledge gained from a data communication course not only enhances employability but also opens up diverse and lucrative career opportunities in a rapidly evolving technological landscape.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Data Structures		
Course Type	Major		
Course Level	200-299		
Course Code	MG3DSCUCO203		
Course Overview	This course provides an in-depth exploration of data structures, which are essential for organizing and managing data efficiently in computer programs. Students will learn how to implement, analyze, and apply various data structures to solve complex computational problems.		
Semester	III	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	40	40	
Pre-requisite	• Basic knowledge of programming concepts. • Basic knowledge of discrete mathematics.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Design an algorithm for a computational task and calculate the time/space complexities of that algorithm.	U, A, C	1
2	Apply the fundamental data structures to solve real-world problems.	U, A	1,2
3	Develop the ability to implement trees and graphs in a programming language.	U, A, An	1,2
4	Select appropriate sorting algorithms to be used in specific circumstances. Utilise advanced data structures in practical applications.	U, A	1,3,6
5	Document, present, and demonstrate the concepts of data structures, including their features, implementation, and applications, in a clear and effective manner using appropriate programming tools and techniques.	R, U, A, E	1,2,3,4 ,5,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No.**
Basic Concepts: System Life Cycle, Algorithm Specification- Recursive Algorithms, Data Abstraction, Performance Analysis, Linear and Non Linear Data Structures, Arrays, Structures and Unions.	15	1,5
Module 2	**Hours**	
Stacks, Queues and Linked Lists: Stacks- Operations, Evaluation of Arithmetic Expressions, Queues- Operations, Circular Queue, Deque, Priority	25	2,5

Queue, Linked Lists- Operations, Linked Implementation of Stacks and Queues, Singly Linked Lists, Doubly Linked Lists, Circularly Linked Lists.		
Module 3	**Hours**	
Trees and Graphs: Representation of Trees, Binary Tree, Binary Tree Traversals, Threaded Binary Trees, Heaps, Graph- ADT, Graph Representations, Graph Traversals.	20	3,5
Module 4	**Hours**	
Sorting, Hashing and Searching: Sorting Techniques– Selection Sort, Insertion Sort, Quick Sort, Merge Sort and Heap Sort, Hashing, Search Structures- Optimal Binary Search Trees, AVL Trees, B-Trees. Applications of advanced data structures in modern industries like big data, AI, IoT, and blockchain.	20	4,5

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative. **Field activities:** Understand to implement, analyze, and optimize data structures.
Mode of Assessment	**A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum Two (Extended answers / Practical) ● Seminar ● Assignment – Written, Practical, Oral Presentation and Viva ● Case study/ Mini project **B. Semester End Examination**

Learning Resources

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press.

2. Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, Data Structures Using C, First Edition, Pearson.

3. Benjamin Baka, Python Data Structures and Algorithms: Improve application performance with graphs, stacks, and queues, Third Edition, Packt Publishing.

Relevance of Learning the Course/ Employability of the Course
Understanding data structures allows for the creation of efficient algorithms that can handle large datasets and complex problems. Efficient data structures lead to faster and more responsive applications, which is critical in competitive software development.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Database Management Systems		
Course Type	Minor		
Course Level	200-299		
Course Code	MG3DSCUCS221		
Course Overview	This course introduces the design, implementation, and management of database systems. It covers fundamental concepts and techniques necessary to understand and effectively utilize databases.		
Semester	III	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	40	40	
Pre-requisite	Basic knowledge of fundamental concepts in computer science such as algorithms, data structures, and basic programming.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Illustrate the fundamental database concepts.	R, U, A	2
2	Construct the theoretical foundations of relational algebra with practical implementations in SQL.	A, An, C	1,3
3	Justify and optimize normalized database designs for performance.	A, An, E	1
4	Develop indexes in popular database management systems. Criticise various strategies to protect data from loss or corruption.	U, A, E	3,4,6
5	Document, present, and demonstrate concepts of database management systems, including features, architecture, and programming, in a very clear and effective manner with the aid of appropriate tools and technologies.	R, U, A, E	1,2,3,4 ,5,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No.
Basic Concepts: Characteristics of the Database Approach, Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Database Languages, Database Architectures and Classification, Data Modeling Using the Entity–Relationship (ER) Model.	15	1,5
Module 2	**Hours**	
Basic SQL, Relational Algebra: SQL Data Definition and Data Types, Constraints, Simple SQL commands, Complex	25	2,5

SQL Queries, Joins, Assertions and Triggers, Views, Altering Schemas. Unary Relational Operations, Binary Relational Operations, Relational Database Design Using ER-to-Relational Mapping.		
Module 3	**Hours**	
Normalization, Indexing: Functional Dependencies, Normal Forms, Lossless Join and Dependency Preserving Decomposition. Files, Blocks, and Records, Heap Files, Sorted Files, Hashing Techniques, Single-Level and Multi-Level Indexes.	20	3,4,5
Module 4	**Hours**	
Transaction Processing, Concurrency Control, **and Recovery, Database Security:** Transaction Processing Concepts, Desirable Properties of Transactions, Characterizing Schedules- Based on Recoverability, Serializability, Two-Phase Locking Techniques, Basic Recovery Techniques. Introduction to Database Security, Access Control. Modern Trends in Database Technologies.	20	4,5

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative. **Field activities:** Understand the activities for maintaining the reliability, performance, and security of a DBMS.
Mode of Assessment	**A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum Two (Extended answers / Practical) ● Seminar

	● Assignment – Written, Practical, Oral Presentation and Viva ● Case study/ Mini project **B. Semester End Examination**

Learning Resources

1. Elmasri Ramez, Navathe Shamkant, Fundamentals of Database Systems, 7th Edition, Addison-Wesley.
2. Sliberschatz A., H. F. Korth and S. Sudarshan, Database System Concepts, 7th Edition, McGraw Hill.
3. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill Education.

Relevance of Learning the Course/ Employability of the Course
Enhances skills in designing robust database schemas that support efficient data management. Emphasizes the importance of securing data against unauthorized access and breaches. Encourages innovative thinking in how to store, manage, and utilize data. Organizations with well-managed databases can gain a competitive advantage through better data utilization. Understanding DBMS is crucial for integrating databases with other IT systems, such as ERP, CRM, and web applications.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Computational Intelligence - AI in Problem Solving		
Course Type	MDC		
Course Level	200-299		
Course Code	MG3MDCUCS201		
Course Overview	Computational Intelligence - AI in Problem Solving introduces advanced AI techniques for solving complex problems. Topics include evolutionary algorithms, fuzzy logic, and neural networks. Students learn to apply these methods to optimize solutions in various domains such as optimization, pattern recognition, and decision-making. Emphasis is placed on practical applications through hands-on projects, exploring how computational intelligence can enhance problem-solving capabilities in real-world scenarios. Ethical considerations and emerging trends in AI are also discussed.		
Semester	III	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	35	20	
Pre-requisite	• Basic Computer Knowledge		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Implement evolutionary algorithms, and knowledge representation mechanisms to solve complex problems in optimization and decision-making.	A, C	PSO1, PSO2
2	Develop problem-solving algorithms and search techniques using fuzzy logic to understand reasoning with uncertain knowledge.	E	PSO1, PSO2, PSO3
3	Critically assess the effectiveness and ethical importance of different computational intelligence approaches in game playing and language processing.	C,S	PSO2, PSO3
4	Innovate and propose novel AI-driven solutions to real-world problems, demonstrating proficiency in advanced problem-solving techniques.	An,C,S	PSO2, PSO5, PS06

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Introduction to AI and Knowledge Representation: Applications of AI, Types of Agents, Structure, Behaviour and Environment of Agents. Knowledge Representation: Propositional Logic, First Order Predicate Logic, Semantic Nets, Neural Networks	15	CO1, CO4
Module 2	**Hours**	
Reasoning with Uncertain Knowledge: Introduction to Fuzzy Sets and Fuzzy Logic, Problem Solving and Searching Techniques	20	CO2
Module 3	**Hours**	

Game Playing, NLP, Ethics in AI: Introduction to Game Playing, Understanding Natural Languages, Ethics in AI, Fairness in AI, Legal Perspective	20	CO3, CO4

Mode of Transaction	**Classroom activities:** ● Use of ICT tools in conjunction with traditional class room teaching methods ● Interactive sessions, Class discussions ● Seminar and Assignment **Field activities:** **Lab based activities:** • Implement each topic in lab to learn the logic behind it.
Mode of Assessment	• Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Practical, Oral Presentation and Viva • Semester End Examination

Learning Resources

1. Russell, S., & Norvig, P. Artificial Intelligence: A Modern Approach. 4th edition. Pearson Education.
2. Goodfellow, I., Bengio, Y., & Courville, A. Deep Learning. MIT Press.
3. Chollet, F. Deep Learning with Python. Manning Publications.

Relevance of Learning the Course/ Employability of the Course

Learning Computational Intelligence - AI in Problem Solving is vital as it equips individuals with advanced techniques to tackle complex challenges in diverse fields. Proficiency in evolutionary algorithms, fuzzy logic, and neural networks enhances employability in roles like AI researcher, optimization specialist, or data scientist. Organizations seek experts capable of developing innovative solutions using computational intelligence, driving efficiency and innovation. Mastery in this domain

ensures readiness to address intricate problems and contribute to technological advancements in various industries.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Security & Ethics in Cyber World		
Course Type	VAC		
Course Level	200-299		
Course Code	MG3VACUCS201		
Course Overview	The "Security & Ethics in Cyber World" course explores fundamental cybersecurity concepts, ethical challenges, and emerging threats in the digital age. It covers topics like cryptography, network security, privacy laws, cybercrime, and ethical decision-making. Students will gain practical knowledge and skills to address security risks while navigating ethical dilemmas in cybersecurity, preparing them for real-world digital challenges.		
Semester	III	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	40	10	
Pre-requisite	Basic understanding of computer networks and information systems.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Understand core concepts of cybersecurity, including threats, vulnerabilities, and protection mechanisms.	U	1
2	Analyze and assess various ethical issues and dilemmas in the context of cybersecurity.	An, E	1,2
3	Implement security measures to protect systems and data. Evaluate privacy laws and their ethical implications in the digital world.	A, C, E, S	1,3,4, 5,6
4	Assess and address emerging cybersecurity challenges, including new technologies like blockchain, IoT, and AI, from both a technical and ethical standpoint. Document, present and demonstrate the above concepts of in a very clear and effective way with the aid of appropriate tools.	A, S	2,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Overview of Cybersecurity: Types of Cybersecurity (Network Security, Application Security, Information Security), Cyber Threats and Vulnerabilities: Phishing, Malware, Denial of Service Attacks, Cryptography and Network Security, Security Threats and Mitigation Techniques	15	1,4
Module 2	**Hours**	
Ethical Challenges in Cybersecurity: Introduction to Cyber Ethics, Intellectual Property Rights and Piracy, The Ethics of Hacking and Ethical Hacking, Case Studies on Ethical Issues in Cybersecurity, Privacy in the Digital Age, Cybercrime and Legal Implications	18	2,3,4

Module 3	Hours	
Advanced Topics in Security and Ethical Decision-Making: Blockchain Technology and its Security Implications, Security in Cloud Computing, Internet of Things (IoT) Security Challenges, Artificial Intelligence in Cybersecurity, Future Trends and Challenges.	12	3,4

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction: Active co-operative learning, Seminar, Group Assignments, Debates Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative. **Field activities:** Understand the effective implementation of Security technologies in Industries. **Lab based activities**
Mode of Assessment	A. Continuous Internal Assessment (CIA) ● Internal Tests – Minimum Two ● Seminar ● Assignment – Written, Oral Presentation and Viva B. Semester End Examination

Learning Resources

1. William Stallings, *Cryptography and Network Security*, Pearson.
2. Richard A. Clarke, *Cyber War: The Next Threat to National Security and What to Do About It*, HarperCollins.
3. Michael E. Whitman, *Principles of Information Security*, Cengage Learning.
4. Bruce Schneier, *Secrets and Lies: Digital Security in a Networked World*, Wiley.
5. Cyberethics: *Morality and Law in Cyberspace*, Richard Spinello.

Relevance of Learning the Course/ Employability of the Course
The "Security & Ethics in Cyber World" course is highly relevant in today's digital landscape, where cybersecurity threats and ethical challenges are pervasive. As organizations increasingly rely on digital systems, the demand for skilled professionals in cybersecurity is growing rapidly. This course equips students with the technical skills and ethical awareness necessary for roles in cybersecurity analysis, ethical hacking, data protection, and digital forensics. Graduates will be well-prepared for positions such as security consultants, information security officers, compliance analysts,

and cybersecurity researchers, enhancing their employability in various industries, including finance, healthcare, government, and technology.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Operating Systems		
Course Type	Major		
Course Level	200-299		
Course Code	MG4DSCUCO201		
Course Overview	This course provides a structured outline on Operating Systems, catering to graduate students in computer science. It includes the essential components and learning objectives for a comprehensive understanding of operating systems. Key topics include process management, memory management, file systems, I/O systems		
Semester	IV	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Basic knowledge about the Computer		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Understand basic OS Concepts-Process and Threads	U	1
2	Analyse Process Management and Synchronization	U, An	1
3	Analyse Memory Allocation Strategies	An	2
4	Illustrate I/O systems and File Allocation Methods	R, U, An	6
5	Document and demonstrate the concepts of Process, Memory, I/O systems and File management in a very clear and effective way	A, An	6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Introduction: History and Evolution of OS, Types of Operating Systems, Operating Systems for Personal Computers, Real time Systems, Operating System Services. **Process and Threads**: Process Concept, Operations on Processes, Inter process Communication, Threads, Threading Issues, Thread Libraries	15	1
Module 2	**Hours**	

Process Synchronization: The Critical Section problem, Mutex locks, Semaphores, Classical Problems of Synchronization. **CPU scheduling**: Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Real-Time CPU Scheduling, **Deadlocks:** Deadlock Characterization, Methods of Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock	15	2,5
Module 3	**Hours**	
Memory Management: Memory Allocation Strategies– Fixed and Variable Partitions, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Virtual Memory Management, Demand Paging, Page Replacement	15	3,5
Module 4	**Hours**	
Storage and I/O Systems: Mass-storage Structure, Disk Scheduling, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem. **File systems:** File Concepts, Access Methods, Directory Structure, File System Structure, File Allocation Methods, Free Space Management, Advanced topics in Operating Systems-Virtualization	15	4,5

Mode of Transaction	**Classroom activities** • Direct Instruction: Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments • Authentic learning: Library work and Group discussion, Presentation by individual student/Group representative.
Mode of Assessment	A. Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Practical, Oral Presentation and Viva B. Semester End Examination

Learning Resources

1. A. Silberschatz, P.B. Galvin, G. Gagne, Operating Systems Concepts, 10th Edition, John Wiley Publications.

2. William Stallings, Operating Systems: Internals and Design Principles, 7th Ed., Prentice-Hall.

3. A.S. Tanenbaum, Modern Operating Systems, Pearson Education.

Relevance of Learning the Course/ Employability of the Course
Learning about operating systems is crucial for a comprehensive understanding of computer science and IT. It provides the essential knowledge needed for a wide range of technical careers and is fundamental to advancing in areas such as software development, system administration, and network management. The skills acquired from an operating systems course are highly sought after, leading to diverse career opportunities and enhancing employability in the ever-evolving tech industry.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Object Oriented Programming using Java		
Course Type	Major		
Course Level	200-299		
Course Code	MG4DSCUCO202		
Course Overview	This course helps to create in-depth knowledge in object oriented programming concepts and to develop programming language skills. The students are also exposed to the advanced features available in Java such as exception handling, file handling, interfaces, packages and GUI programming.		
Semester	IV	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	40	40	
Pre-requisite	Basic programming knowledge.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.

	Upon completion of this course, students will be able to;		
1	Understand object oriented programming concepts for implementing classes, objects and the relationships among them using Java.	R,U	1, 2
2	Implement threads, efficient programs in Java and manage errors by applying exception handling.	A,S	1, 2, 3
3	Design and develop complex Graphical User Interfaces using applets and Evaluate the connection of interface and database with the help of JDBC.	An, C, S	1, 2, 4
4	Analyse abstract user interface components, event handlers and design GUI using AWT along with response to events.	E,S	1, 5
5	Design and demonstrate real world Java applications that automate manual process and interpret its relevance.	C,S	5, 6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Introduction: Object Oriented Programming, Comparison between Procedural and Object Oriented Programming, Basic Principles of Object Orientation, Introduction to Java: Java Virtual Machine, Java Program Language Components.	15	1,5
Module 2	**Hours**	
I/O, Threads and Exception Handling: Introduction to Classes and Methods, Input and Output, File Class, **Threads:** Threads vs. Processes, Creating Threads, Synchronization. **Exceptions:** Exception Handling, Developing User Defined Exception Classes.	20	2,5
Module 3	**Hours**	

Database Connectivity & GUI: Introduction to JDBC: The JDBC Connectivity Model, Database Programming, Connecting to the Database, Creating a SQL Query. **Introduction to GUI Applications** - Applets - Types of Applet, Applet Skeleton, HTML Applet Tag and Passing Parameter to Applet.	25	3, 5
Module 4	**Hours**	
Events and GUI Applications: Event Handling: The Delegation Event Model, Event Classes, Event Listener Interfaces, Adapter Classes. Introduction to the AWT: Containers, Components, Canvas, Frame Working Attributes, Simple Graphics, Controls. **Java Project/Case Study**	20	4,5

Mode of Transaction	**Classroom activities:** ● Lecturing, Discussions, Writing Programs ● Seminar and Assignment **Field activities:** **Lab based activities:** • Implement each topic in lab to learn the logic behind it.
Mode of Assessment	• Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Practical, Oral Presentation and Viva • Semester End Examination

Learning Resources

1. Schildt, H. Java: The Complete Reference. 13th edition. McGraw-Hill Education.

2. Balaguruswamy E. Programming with JAVA. 7th edition. India: McGraw Hill Education

3. Horstmann, C. S. Core Java - Vol. I – Fundamentals (Vol. 10). Pearson Education

4. Mark Reed. Java : The ultimate beginners guide to effectively learn java programming step-by-step, Publishing Factory LLC.

Relevance of Learning the Course/ Employability of the Course

Learning Object Oriented Programming in Java is crucial as it forms the foundation for advanced Java technologies and frameworks, enhancing employability in the software development industry. Core Java skills are in high demand due to the widespread use of Java in enterprise applications, Android development, and web services. Proficiency in Java improves job prospects, enabling roles such as software engineer, backend developer, and systems architect. Mastery of Java ensures a solid understanding of object-oriented programming, essential for modern software solutions.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Microprocessors		
Course Type	Major		
Course Level	200-299		
Course Code	MG4DSCUCO203		
Course Overview	The course highlights the evolutionary architectural concepts and functions of the microprocessors from 8086, 80486 and Pentium IV in detail. It also provides low level programming skills through Assembly Language Programming features of 8086 microporcessor and an introduction to multicore architectures. The students after studying this course will be able to go deep into the architecture and working of the above specified single and multicore microprocessors within computers. They can create and apply ALP features using 8086 Instruction Set for solving problems that can input, process and output data including interrupts, directly with the microprocessor. Thus they will be equipped with various technical and programming skills to identify efficient computers and to generate efficient and executable low level programs.		
Semester	IV	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	40	40	

Pre-requisite	• Basic knowledge of programming concepts. • Familiarity with binary numbers and basic algebra.

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to**;***	Learning Domains	PSO No.
1	Understand and Illustrate the structure and functionalities of architectural components of microprocessors.	R, U, An	1,3
2	Analyze the Instruction sets, create Assembly Language programs and evaluate the pros and cons of various addressing modes of the instructions.	U, A, C	1,2,5,6
3	Evaluate various architectural components of single core and multicore microprocessors and suggesting innovative proposals.	An, E	1,3,4, 6
4	Understand, create and utilize the input/output and memory management systems and programming features.	U, E	1,5,6
5	Document, present and demonstrate concepts of microprocessor features, architecture and programming in a very clear and effective way with the aid of appropriate tools.	R, U, A, E	1,2,3,4 ,5,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No.
Introduction to Microprocessors, Evolution of microprocessors till 8086, Intel 8086 Microprocessor, Architecture, Interrupts, Memory and I/O Port Addresses, Architecture of 80486 Microprocessor, Memory	25	1,2,3,4, 5

Management, Operating modes, Paging Mechanism, Cache Memory Techniques.		
Module 2	**Hours**	
Assembly Language Programming, Instruction Sets, Programming features, Keyboard and String operations, Defining and using Macros.	20	1,3,4,5
Module 3	**Hours**	
Pentium Microprocessors, Pentium IV Architecture, Advanced Features, 20-stage pipelining, Memory Sub system, New Instructions for Pentium IV, Comparison of Pentium Processors II,III and IV.	20	1,3,4,5
Module 4	**Hours**	
Introduction to Multicore Processors, Shared and Non-shared Memory Architectures, Introduction to Interconnection networks among multiple cores, Case Study - Intel multicore Processors.	15	1,3,4,5

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative. **Field activities:** Understand large-scale memory management, data storage solutions, and high-performance computing environments.
Mode of Assessment	**A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum Two (Extended answers / Practical) ● Seminar ● Assignment – Written, Practical, Oral Presentation and Viva ● Case study/ Mini project **B. Semester End Examination**

Learning Resources

1. A. K. Ray & K. M. Bhurchandi, Advanced Microprocessors and Peripherals- Architectures, 3e, McGrawHill Education (India)Pvt. Ltd.
2. Berry.B.Brey, The Intel Microprocessors 8086/8088 /80186/80188, 80286, 80386,80486 PENTIUM, PENTIUM Pro, PII, PIII & IV Architecture, Programming & Interfacing, Pearson Education.
3. Multi Core Processors and Systems, Keckler, Stephen W., Kunle, Olukotun, Hofstee, H.Peter (Eds), Springer.
4. Abel P., IBM PC Assembly Language and Programming, Fifth Edition, Pearson Education, Asia.
5. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press.

Relevance of Learning the Course/ Employability of the Course
The students will be equipped with various technical and programming skills to identify efficient computers and to generate efficient and executable low level programs. They can get placed in jobs like hardware designers, system software engineers etc. and they are paid more than a normal software engineer or developer.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Software Engineering		
Course Type	Minor		
Course Level	200-299		
Course Code	MG4DSCUCS241		
Course Overview	The course covers the theoretical concept of the design, analysis, and implementation of software development process. Areas include software requirement engineering, Process Models, Object oriented design concepts, Project management concept and solving real world practical problems. This course gives awareness on information Ethics that must be kept throughout the software development process.		
Semester	IV	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	• The learner must have gained the fundamental concepts of software. Basic knowledge of programming concepts.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Practice on Information Ethics and Software Engineering	R, U	1,3
2	Understand and formulate Software Requirement Engineering	A, An, S, E	1,2,3,4 ,5
3	Expertise in Object Oriented Software Design	A, S , An, C, E	1,3,6
4	Identify design problem and analyze Software Quality Assurance. Manage and develop Software using software project management. Formulate and evaluate possible software development process models in advance level	U, A, An, S, C, E	1,2,3,4 ,5,6
5	Demonstrate the ability to analyze, design, apply and use of software requirement engineering and quality assurance in software project	U, A, An, E, C , S	1,2,3,4 ,5,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No.**
Foundations of Software Engineering: Information and Computer Ethics, Software and Software Engineering, Software Process Models: Waterfall, Incremental, Agile, and DevOps. Principles that Guide Practice.	10	1, 4
Module 2	**Hours**	

Understanding Requirements, Requirements Modeling: Scenarios, Information, and Analysis Classes, Requirements Modeling for WebApps, Design Concepts, Software Architecture: Definition, Importance and Styles, User Interface Design.	15	2, 5
Module 3	**Hours**	
Object Oriented Software Design using UML, Class Diagram, Deployment Diagram, Use case Diagram, Sequence Diagram, Communication Diagram, Activity Diagram, State Diagram.	15	3,5
Module 4	**Hours**	
Quality Concepts, Software Quality Assurance, Software Configuration Management, Product Metrics, Software Testing Strategies-Testing Conventional Applications, Testing Object-Oriented Applications, Testing Web Applications. Project Management Concepts, Process and Project Metrics, Estimation for Software Projects, Project Scheduling, Risk Management. Searching and Application.	20	4,5

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction: Active co-operative learning, Seminar, Group Assignments Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative. **Field activities:**
Mode of Assessment	**A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum Two (Extended answers / Practical) ● Seminar ● Assignment – Written, Practical, Oral Presentation and Viva ● Case study/ Mini project **B. Semester End Examination**

Learning Resources

6. Pressman, R.S., Software Engineering: A Practitioner's Approach, MGHISE, 9th Edition.
7. Bernd Bruegg and Allen H, Object Oriented Software Engineering Using UML, Patterns and Java, 2nd Edition.
8. Rajib Mall, Fundamentals of Software Engineering,4th Edition, PHI.

Relevance of Learning the Course/ Employability of the Course
This course is very important in terms of employability of the students. The Course focuses on software research and development job opportunities in the industries such as Software consultant, Software Designer, Software Testing, Software Developer, Project Manager, SEO, Software Marketing and programmer.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Web Technologies		
Course Type	SEC		
Course Level	200-299		
Course Code	MG4SECUCS201		
Course Overview	This course covers the essential tools for modern web development. Students will learn HTML to structure web content, CSS to style and enhance presentation, and JavaScript to add interactivity and dynamic behaviour. Additionally, the course introduces XML for data storage and interchange. Through a combination of theoretical knowledge and practical exercises, students will gain the skills necessary to create, design, and manage web applications, ensuring a comprehensive understanding of web technologies.		
Semester	IV	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	35	20	

Pre-requisite	Basic Computer Skills

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome *Upon completion of this course, students will be able to;*	Learning Domains	PSO No.
1	Create HTML pages	C, S	1, 2
2	Style webpages using CSS and Embedding JavaScript into HTML	S, E, C	1, 4
3	Create XML documents	E, C, S, A	1, 6
4	Design, develop and present a web application with the help of appropriate aids	E, A, S	5, 6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Introduction to Web: Web site - Static and Dynamic web site, Web application - Client-server, Web development Technologies **HTML:** Introduction to HTML, HTML element/tag & attributes, HTML tags, attributes, and elements, Creating lists, tables, and forms, Embedding images, audio, and video	20	1,4
Module 2	**Hours**	
CSS: Introduction to CSS, Syntax, Selectors, Embedding CSS to Html, Formatting fonts, Text & background colour, Borders & boxing	20	2,4

JavaScript: Introduction to JS, Embedding JS into Html, Variables, Data types, Operators, Conditional statements, Looping statements, Strings, Arrays, Functions, Objects, Event Handling		
Module 3	**Hours**	
XML: Introduction to XML, Difference b/w HTML & XML, XML editors, XML Elements & Attributes, XML DTD, XML Schema, Database Connectivity, Recent trends in web development	15	3,4

Mode of Transaction	**Classroom activities** • Direct Instruction: Explicit Teaching, E-learning • Interactive Instruction: Active co-operative learning, Seminar, Group Assignments • Authentic learning: Library work and Group discussion, Presentation by individual student/Group representative.
Mode of Assessment	C. Continuous Internal Assessment (CIA) • Internal Tests – Minimum Two • Seminar • Assignment – Written, Practical, Oral Presentation and Viva D. Semester End Examination

Learning Resources

1. Pfaffenberger, B. HTML, XHTML, and CSS Bible. John Wiley & Sons.
2. Kogent Learning Solutions Inc. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Dreamtech Press
3. Russ/Heilmann Ferguson (Christian). Beginning JavaScript with DOM Scripting and Ajax. Springer Verlag.
4. Kevin Howard Goldberg , XML: Visual Quickstart Guide ,2nd Edition Peachpit Press

Relevance of Learning the Course/ Employability of the Course
Studying a Web Technology course is highly relevant as it provides essential skills for creating, designing, and managing websites and web applications. These skills are crucial in today's digital world, where the internet is a primary tool for communication, commerce, and information dissemination. The employability of web technology professionals is high, with diverse roles such as web developer, designer, and UI/UX specialist. Additionally, web technology skills enable freelancing and entrepreneurship opportunities,

often with competitive salaries and the flexibility of remote work. This makes it a valuable and versatile field of study.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Computer Sciences		
Programme	4 + 1 Integrated UG and PG Programme		
Course Title	Green Computing		
Course Type	VAC		
Course Level	200-299		
Course Code	MG4VACUCS201		
Course Overview	The course on Green Computing provides an understanding and evaluation of the various concepts such as Green Computing Technologies, Sustainable Development Goals (SDGs), Internet Connectivity Architecture and Sustainability Considerations, Polymer Optical Fiber (POF), Sustainable Development in the Post-Covid Era.		
Semester	IV	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	45		
Pre-requisite	General concepts of computing systems		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Understand and analyse the Green computing methololgy, technologies and tools.	R, U, An	1,3
2	Analyse and evaluate the application of technology tools and case studies.	U, A, C	1,2,5,6
3	Adopt and Evaluate the effects of Gas and energy emissions and acquire skill in energy saving practices in the use of hardware.	R, U, An, A	1,3,4, 6
4	Document, present and demonstrate concepts of Green Computing in a very clear and effective way with the aid of appropriate tools.	R, U, A, E	1,2,3,4 ,5,6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No.
Introduction to Green Computing: Green Computing Technologies, Data Centers and Cloud Computing Services, Green Renewable Energies, Challenges and Innovations, Ultra-Wideband Programmable Communication Systems, Energy Harvesting Systems for 5G, IOT, Medical and Computer Industry, Wideband Energy Harvesting Systems and Applications	15	1,2,3,4
Module 2	**Hours**	
SDGs, Internet Connectivity Architecture and Sustainability Considerations: Building Internet of Things (BIoT), Sustainability Issues, Research Relating Architecture with RF, Guidelines by BUET Study, Covid Pandemic Issues and Other Conflicting Needs, Computer-based Wastes and Energy-intensive Computing.	20	1,3,4
Module 3	**Hours**	
Polymer Optical Fiber Splitter: POF Technology, Short Distance Transmissions, Macro Bending Loss, Analytical Concepts, Lapping Technique.	10	1,3,4

Mode of Transaction	**Classroom activities:** Direct Instruction: Brain storming lecture, Explicit Teaching, E-learning, Interactive Instruction: Active co-operative learning, Seminar, Group Assignments, Debates Authentic learning: Library work and Group discussion, Presentation by individual student/ Group representative. **Field activities:** Understand the effective implementation of Green Computing technologies in Industries.
Mode of Assessment	**A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum Two (Extended answers) ● Seminar ● Assignment – Written, Oral Presentation and Viva ● Case study **B. Semester End Examination**

References

1. Albert Sabban, Green Computing Technologies and Computing Industry in 2021, IntechOpen, DOI: http://dx.doi.org/10.5772/intechopen.96847.
2. Carl speshocky, “Empowering Green Initiatives with IT”, John Wiley & Sons.
3. John Lamb, “The Greening of IT”, Pearson Education.
4. Oyile Paul Oduor * and Wabwoba Franklin, The evolution of green computing: Current practices and societal implications, DOI: https://doi.org/10.30574/wjaets.2024.13.2.0622.
5. Article Online: Green_Computing(Academia), https://www.academia.edu/33424962/green_computing_pdf.
6. Wu Chun Feng (editor), “Green computing: Large Scale energy efficiency”, CRC Press.

Relevance of Learning the Course/ Employability of the Course
The students will be equipped with various theoretical and technical abilities to construct and maintain energy efficient sustainable computing environments and minimize the production of heat and hazardous gases, e-waste and electrical energy. They will get placed in software research and development companies and in Green computing divisions of government.