MAHATMA GANDHI UNIVERSITY

SCHOOL OF COMPUTER SCIENCES

M.Sc. Computer Science

Scheme and Syllabi in OBE Framework from 2021 Admission onwards

(based on CSS 2020 Regulations)

SUBMITTED IN

December 2021

Vision

To emerge as a centre of excellence in knowledge generation and dissemination for moulding technically competent and socially committed computer scientists/professionals for nation building.

Mission

To provide a conducive environment for teaching, research and learning leading to the overall holistic development of students

To foster research and extension activities for the development of the society

To develop skilled manpower for providing intellectual leadership to the community so as to meet global demands

MAHATMA GANDHI UNIVERSITY

SCHOOL OF COMPUTER SCIENCES

SCHEME 2021

PROGRAMME: **M.Sc. Computer Science** FACULTY OF **SCIENCE**

DURATION: **4 Semesters** Minimum Total Credits Required: **84**

Revised Syllabus 2021: Semester wise List of Courses

Semester I

Course Code	Course Title	Hours/Week			Credits
		L	T	P	
CO M 21 C 11	Operating Systems and Virtualization	3	1	2	4
CO M 21 C 12	Multicore Microprocessors and Parallel Programming	3	2	3	4
CO M 21 C 13	Algorithms and Complexity	3	2	3	4
CO M 21 C 14	Artificial Intelligence	3	2	-	4
CO M 21 E 1*	Elective – I	3	1	2	3
CO M 21 C 15	Case Study using Python-Lab	-	1	6	2
Total Credits (Semester I)					21

Semester II

CO M 21 C 21	Machine Learning	3	1	2	4
CO M 21 C 22	Digital Image Processing	3	2	3	4
CO M 21 C 23	Data Mining	3	2	3	4
CO M 21 C 24	Software Engineering	3	-	2	4
CO M 21 E 2*	Elective – II	3	1	2	3
CO M 21 C 25	Minor Project using Advanced Java and Object Oriented Analysis and Design –Lab	-	1	6	2
Total Credits(Semester II)					21

Semester III

CO M 21 C 31	Theoretical Computer Science	3	2	-	4
CO M 21 C 32	Deep Learning	3	2	1	4
CO M 21 E 3*	Elective – III	3	1	2	3
CO M 21 E 3*	Elective – IV	3	1	2	3
CO M 21 C 33	Deep Learning-Lab	-	1	6	2
CO M 21 C 34	Advanced Software Development Tools-Lab	-	1	3	2
CO M 21 O 31	Open Course	3	1	2	4
Total Credits(Semester III)					22

Semester IV

CO M 21 C 41	Main Project& Comprehensive Viva-voce	One Semester	20
Total Credits(Semester IV)			20

Total Credits for the M Sc Programme : 84

Scheme and Syllabi in OBE Framework effective from 2021 Admission onwards
(Based on CSS 2020 Regulations)

ELECTIVES

Course Code	Course Title	Hours/Week			Credits
		L	T	P	
CO M 21 E 11	Cyber Security and Cyber Laws	3	1	2	3
CO M 21 E 12	Advanced Data Structures	3	1	2	3
CO M 21 E 13	3D Graphics	3	1	2	3
CO M 21 E 21	Wireless Communication and Sensor Networks	3	1	2	3
CO M 21 E 22	Cyber Physical Systems	3	1	2	3
CO M 21 E 23	Distributed Systems and Parallel Computing	3	1	2	3
CO M 21 E 31	Data Science	3	1	2	3
CO M 21 E 32	Internet Of Things and Block Chain Technologies	3	1	2	3
CO M 21 E 33	Cloud Computing	3	1	2	3
CO M 21 E 34	Fuzzy Logic and Nature Inspired Computing	3	1	2	3
CO M 21 E 35	Natural Language Processing	3	1	2	3
CO M 21 E 36	Digital Signal Processing and Speech Technologies	3	1	2	3

Graduate Attributes of Mahatma Gandhi University

Critical Thinking and Analytical Reasoning	Capability to analyse, evaluate and interpret evidence, arguments, claims,beliefs on the basis of empirical evidence; reflect relevant implications to the reality; formulate logical arguments; critically evaluate practices, policies and theories to develop knowledge and understanding; able toenvisage the reflective thought to the implication on the society.
Scientific Reasoning and Problem Solving	Ability to analyse, discuss, interpret and draw conclusions from quantitative/qualitative data and experimental evidences; and critically evaluate ideas, evidence and experiences from an unprejudiced and reasoned perspective; capacity to extrapolate from what one has learned and apply their competencies to solve problems and contextualise into research and apply one's learning to real life situations.
Multidisciplinary/ Interdisciplinary/ Transdisciplinary Approach	Acquire interdisciplinary /multidisciplinary/ transdisciplinary knowledge base as a consequence of the learning they engage with their programme of study; develop a collaborativemultidisciplinary/ interdisciplinary/transdisciplinary- approach for formulate constructive arguments and rational analysis for achieving common goals and objectives.
Intra and Interpersonal Skills	Ability to work effectively and respectfully with diverse teams; facilitate collaborative and coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team; lead the team to guide people to the right destination, in a smooth and efficient way.
Digital literacy	Capability to use ICT in a variety of learning situations, demonstrate ability to access, choose, collect and evaluate, and use a variety of relevant information sources; structure and evaluate those data for decision making.
Global Citizenship	Building a sense of belonging to a common humanity and to become responsible and active global citizens. Appreciation and adaptation of different sociocultural setting.
Social Competency	Possess knowledge of the values and beliefs of multiple cultures, appreciate and adapt to a global perspective; and capability to effectively engage in a multicultural society and interact respectfully, manage and lead with diverse groups.
Equity, Inclusiveness and Sustainability	Appreciate and embrace equity, inclusiveness and sustainability and diversity; acquire ethical and moral reasoning and values of unity, secularism and national integration to enable to act as dignified citizens;

	able to understand and appreciate diversity
Lifelong Learning	Continuous acquisition of knowledge and skills. Learn, unlearn and relearn based on changing ecosystem. "Learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Programme Specific Outcomes (PSO)

PSO1	**Critical Thinking and Evaluation** Critically evaluate ideas, evidence and experiences from an unprejudiced and reasoned perspective;
PSO2	**Scientific Analysis and Reasoning** Ability to analyse, discuss, interpret and draw conclusions from quantitative/ qualitative data and experimental evidences;
PSO3	**Problem Solving** **Capacity to extrapolate and apply their knowledge and competencies to solve problems and contextualise into research and develop relevant software solutions to real life problems.**
PSO4	**Multidisciplinary/Interdisciplinary/Transdisciplinary Approach** **Acquiring knowledge and formulating solutions in interdisciplinary/ multidisciplinary/transdisciplinary levels for problem solving in a collaborative environment.**
PSO5	**Communication Skills** Ability to document, present and demonstrate complex problem solutions in a very clear and effective way with the aid of appropriate tools.
PSO6	**Leadership Skills** Ability to work effectively and lead respectfully with diverse teams, formulating a goal in a smooth and efficient way.
PSO7	**Social Consciousness and Responsibility** **Ability to evolve as a socially committed and responsible scientist/software professional meeting global demands.**
PSO8	**Moral and Ethical Reasoning** **Capable of demonstrating the ability to identify ethical issues related to software development and use ethical practices in all phases of software development/deployment and research and embrace moral/ethical values in conducting one's life.**
PSO9	**Networking and Collaboration** Acquire skills to be able to collaborate and network with scholars in an educational/, professional/research/industry organizations and individuals in India and abroad.
PSO10	**Lifelong Learning** Ability to acquire knowledge and skills through self-paced and self-directed learning and adapt to changing trends and demands of work place through knowledge/skill updation/reskilling.

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 12 OPERATING SYSTEMS AND VIRTUALIZATION

FIRST SEMESTER

School Name	**School of Computer Sciences**					
Programme	**M. Sc.**					
Course Name	**Operating Systems and Virtualization**					
Type of Course	Core					
Course Code	**CO M 21 C 11**					
Names of Academic Staff & Qualifications	Prof. Dr. Bindu V R, M. Sc., Ph. D.					
Course Summary & Justification	The course provides a thorough discussion on the fundamentals of operating system design, relating these to contemporary design issues and current directions in the development of operating systems. The students will get acquainted with the design principles and implementation issues of contemporary operating systems. The students will also get a deep understanding of various types of virtualization techniques, their advantages and disadvantages, in order to be able to apply them in a practical setting. For illustrating the concepts, four operating systems have been chosen as case studies.					
Semester	I					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total LearningHours
	Explicit Teaching Seminar, Assignment, case Study etc.	42	14	28	36	120
Pre-requisite	Overview of Computer System and Operating System – Processes, Memory, Scheduling, Input/Output and Files					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 11 OPERATING SYSTEMS AND VIRTUALIZATION

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Analyse the key design areas that have been instrumental in the development of modern operating systems	U, An	1
2	Elucidate OS design issues raised by the introduction of multiprocessor and multicore organization.	An	1,2
3	Compare and Analyse the structure, functional elements and features of Windows, Traditional and Modern UNIX, Linux and Android operating systems.	An	1,2,4
4	Critically examine the requirements for process control by the OS and analyse the issues involved in the execution of OS code.	A, An	1,2,
5	Develop programs implementing multithreading.	U, A	1,2,3,4
6	Compare and Analyse the process and thread management, the concurrency and synchronization methods and the virtual memory management mechanisms in UNIX, Linux, Solaris, Windows and Android operating systems.	R, U, An	1,2
7	Identify and analyse the key design issues in multiprocessor thread scheduling and some of the key approaches to scheduling and understand the requirements imposed by real-time scheduling.	An	1,2,3
8	Analyse and compare the scheduling methods used in Linux, UNIX SVR4, and Windows 10.	U,An	1,2
9	Critically examine some of the key issues in the design of OS support for I/O and describe the I/O mechanisms in UNIX, Linux, and Windows.	U, An	1,2
10	Define and discuss virtual machines and virtualization and conceptualize and implement the various approaches to virtualization.	U, A, An	1,2,3
11	Conceptualize, formulate and design a sample operating system and document, present and demonstrate concepts in a very clear and effective way with the aid of appropriate tools.	U, A, An, C, E	1,2,3,5,6,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 11 OPERATING SYSTEMS AND VIRTUALIZATION

COURSE CONTENT
Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction - Characteristics of Modern Operating Systems, Symmetric Multiprocessing and Micro-kernels, Virtual Machines, OS Design Considerations for Multiprocessor and Multicore, Windows Overview, Modern UNIX Systems, Linux, Android.	12	1,2,3
UNIT II	Processes and Threads - Process Description and Control, Security issues, UNIX SVR4 Process Management, Threads, Windows Process and Thread Management, Solaris Thread and SMP Management, Linux Process and Thread Management, Android Process and Thread Management, Unix Concurrency Mechanisms, Linux Kernel Concurrency Mechanisms, Solaris Thread Synchronization Primitives, Windows Concurrency Mechanisms, Android Interprocess Communication.	20	4,5,6,11
UNIT III	NIX and Solaris Memory Management, Linux Memory Management, Windows Memory Management, Android Memory Management. Scheduling - Traditional UNIX Scheduling, Multiprocessor and Multicore Scheduling, Real-time Scheduling, Linux Scheduling, UNIX SVR4 Scheduling, Windows Scheduling.	16	7,8,11
UNIT IV	and Files - UNIX SVR4 I/O, Linux I/O, Windows I/O, Unix File Management, Linux Virtual File Systems, Windows File System, Android File Management.	16	9,11
UNIT V	Virtualization Concepts: Introduction to Virtual machines; Process Virtual Machines, System Virtual Machines, Multiprocessor Virtualization, Applications for VM Technology Approaches to Virtualization: Hypervisors, Containers, Processor Issue, Memory Management, I/O Management, VMware ESXi, Microsoft Hyper-V and Xen Variants, Java VM,	20	10,11

	Linux VServer Virtual Machine Architecture, Android Virtual Machine.		

COURSE CONTENT
Content for Classroom Transaction (Sub-units)

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum Two (Extended answers / Practical) ● Seminar – ▪ Research Literature Review ▪ Report Writing ▪ Presentation ● Assignment – Written, Practical, Oral Presentation and Viva ● Case study/ Mini project **B. Semester End Examination**

REFERENCES

1. William Stallings, *Operating Systems: Internals and Design Principles,* 9th Ed, Prentice-Hall.
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, *Operating System Concepts*, 8th Ed, John Wiley.
3. James E. Smith, Ravi Nair, Virtual Machines-Versatile Platforms for Systems and Processes, Morgan Kaufmann Publishers.

4. Matthew Portnoy, Virtualization- Essentials, John Wiley & Sons, Inc.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 12 MULTICORE MICROPROCESSORS AND PARALLEL PROGRAMMING

SchoolName	**School of Computer Sciences**					
Programme	**M.Sc.**					
Course Name	Multicore Microprocessors and Parallel Programming					
Type of Course	Core					
Course Code	**CO M 21 C 12**					
Names of Academic Staff & Qualifications	Prof. Dr. Pushpalatha K P, PhD					
Course Summary & Justification	The course covers the architectures of single and multi-core microprocessors, parallel computer architecture and various parallel programming models and features. The course further discusses parallel programming with OpenMP based on various models, memory subsystem including cache architectures. It also gives training in parallel programming with OpenCL for massively parallel GPUs. The students after studying this course will be able to know the architecture and working of Pentium mircroprocessor and multicore mircroprocessors within a computer. They can understand and apply parallel programming structures and constructs using MPI and OpenCL with Multiple GPU cores for solving problems that need to handle huge quantity of data. Thus they will be equipped with various technical and programming skills to generate parallel executable software. 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.					
Semester	I					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	28	42	8	120
Pre-requisite	Knowledge in 8086 or 80x86 Microprocessors					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 12 MULTICORE MICROPROCESSORS AND PARALLEL PROGRAMMING

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the difference in the features of single core microprocessors and multicore microprocessors.	U	2
2	Conceptualise the specific features of a parallel computer through Flynn's Taxonomy.	U, An	1, 2
3	Illustrate the application of various parallel architectures of Intel Core ix.	U, R, An	2, 3
4	Develop and test software that can do process to process communication using OpenMP.	A, An, C	2, 5, 8, 10
5	Demonstrate the interconnection networks possible within a multicore architecture.	R, U, E	1, 2, 3, 5, 10
6	Evaluate the performance of microprocessors based on memory hierarchy, cache performance and cache designing.	A, An, E	1, 2, 3
7	Research, identify and create alternate solutions for the basic Cache Coherence Issues	An, A, C	2, 3, 7, 10
8	Demo the application of the features of OpenCL to solve problems that needs massively Parallel data handling operations with GPU processors.	A, C, S	3, 4, 5
9	Prepare a report and do a presentation on the comparative study of the applications of MPI and OpenCL on various parallel architectures of Intel Core.	U, R, An	2, 3, 5, 8
10	Document, present and demonstrate concepts of parallel programming in a very clear and effective way with the aid of appropriate tools.	An, E, C	2, 5, 8

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

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 12 MULTICORE MICROPROCESSORS AND PARALLEL PROGRAMMING

COURSE CONTENT
Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Single Core To Multi-core Microprocessors: Introduction to Pentium IV Microprocessors, Architecture, Special Features, Registers, Addressing Modes, Memory Management, New Pentium Instructions. An Introduction to Multicore Processors, Single Core Vs Multicore Processors, Architecture and PIN Descriptions of Intel Core 2 Processors.	**20**	**1,2**
UNIT II	Parallel Computer Architecture, Flynn's Taxonomy of Parallel Architectures, Classes of MIMD Parallel Computers, Parallel Programming Models, Levels of Parallelism, Simultaneous Multithreading (SIMT) Architecture, Energy Consumption of Processors, Architecture of Multicore Processors, Case Study: Architecture of the Intel Core i7, Interconnection Networks, Parallel Computational Complexity, Laws and Theorems of Parallel Computation.	**22**	**3,5**
UNIT III	Shared Memory Parallel Programming using OpenMP, Shared Memory Programming Model, Multithreaded Programs, Parallelization of Loops, Parallel Tasks, MPI Processes and Messaging, Distributed Memory Computers, Message Passing Interface, Basic MPI Operations, Process-to-Process Communication, Collective MPI Communication, Sources of Deadlocks.	**24**	**4**
UNIT IV	Introduction to Memory Hierarchy Organization, Basic Architectures of a Cache, Cache Performance, Prefetching, Cache Designing, Multicore Architecture, Physical Cache Organization, Logical Cache Organization, CaseStudies. Introduction to Shared Memory Multiprocessors, Basic Cache Coherence Issues, Hardware Support for Synchronization, Memory Consistency Models, Advanced Cache Coherence Issues.	**22**	**6,7**

UNIT V	OpenCL for Massively Parallel Graphic Processors, Anatomy of a GPU, Programmer's View of OpenCL, Programming in OpenCL.	**24**	**8,9,10**

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers / Practical) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Practical, Oral presentation and viva ● Case study/Mini project **B. Semester End Examination**

REFERENCES

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. Roman Trobec, Boštjan Slivnik Patricio Bulić, Borut Robič, Introduction to Parallel Computing From Algorithms to Programming on State-of-the-Art Platforms, Springer Nature Switzerland AG 2018, ISSN 1863-7310 ISSN 2197-1781 (electronic).
4. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press.

5. Thomas Rauber, Gudula Runger, Parallel Programming for Multicore and Cluster Systems, Second Edition, Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-37800-3.
6. Aaftab Munshi, Benedict R. Gaster, Timothy G. Mattson, James Fung, Dan Ginsburg, OpenCL Programming Guide, Addison-Wesley, Pearson Education Inc.
7. David W. Walker, Parallel Computing, Encyclopedia of Physical Science and Technology (Third Edition).

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C13 ALGORITHMS AND COMPLEXITY

SchoolName	**School of Computer Sciences**					
Programme	**M.Sc.**					
Course Name	**Algorithms and Complexity**					
Type of Course	Core					
Course Code	**CO M 21 C 13**					
Names of Academic Staff & Qualifications	Dr. Anuj Mohamed, MCA,Ph. D.					
Course Summary & Justification	This course provides knowledge of techniques to design efficient algorithms to solve various types of problems and to make evaluative judgments about the algorithms. It also covers techniques to establish the efficiency of the designed algorithms. It also provides concepts of NP-completeness and to evaluate algorithms accordingly.					
Semester	I					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar Assignments etc.	42	28	42	8	120
Pre-requisite	Design and Analysis of Algorithms, Data Structures, Programming Skills					

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CO M 21 C13 ALGORITHMS AND COMPLEXITY

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Analyse a given algorithm and express its time and space complexities in asymptotic notations.	U, An	1,2, 5
2	Solve recurrence equations using different methods.	Ap	2, 3
3	Describe various techniques for deriving good lower bounds.	U	2, 5
4	Compute the lower bound on the time of an algorithm	A,E	2,3
5	Understand the concept of nondeterministic algorithms	U	1,2
6	Describe computational models for parallel algorithms	U	1,5
7	Implement parallel algorithms for suitable applications	An, C	3
8	Understand concepts of NP-completeness and evaluate algorithms accordingly	U, An, E	1,2,8
9	Distinguish between problems that can be solved by a polynomial time algorithm and problems for which no polynomial time algorithm is known	U, An, E	1,2
10	Apply approximation algorithms to generate feasible solutions for NP-hard problems.	U, A	2,3
11	Design algorithms to solve real-life problems, analyze its complexity and present the approach in an effective way with the aid of appropriate tools.	U,An, C,E	1,2,3,5,8
12	Acquire knowledge and skills through self-paced and self-directed learning and adapt to changing trends through knowledge/skill updation/reskilling.	U, An, A, C, E	7, 8, 10

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

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C13 ALGORITHMS AND COMPLEXITY

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction: The Role of Algorithms in Computing, Design and Analysis Fundamentals, Performance Analysis, Mathematical Background for Algorithm Analysis, Recurrences: Substitution Method, Recursion-Tree Method, Master Method.	16	1,2
UNIT II	Lower Bound Theory: Importance of Lower Bound Theory, Comparison Trees, Adversary Arguments, Lower Bounds through Reductions.	22	3,4
UNIT III	String Matching Algorithms: The Naive String Matching Algorithm, The Rabin-Karp Algorithm, String Matching with Finite Automata, The Knuthmorris-Pratt Algorithm, Longest Common Subsequence.	26	5
UNIT IV	Parallel Algorithms: Sequential vs. Parallel Algorithms; Models: Data Parallel Model, Task Graph Model, Work Pool Model, Master Slave Model, Producer Consumer or Pipeline Model; Hybrid Model; Speedup and Efficiency; Examples of Parallel Algorithms: Parallel Sorting, Parallel Matrix Chain Multiplication.	26	6,7
UNIT V	Introduction to NP-Completeness: The class P and NP, NP-Complete, NP-Hard, NP-Completeness and Reducibility; Cook's Theorem.Approximation Algorithms: Absolute Approximations, Є-Approximations, Polynomial Time and Fully Polynomial Time Approximation Schemes. Vertex Cover Problem, Traveling-Salesman Problem.	22	8,9,10,11,12

CO M 21 C13 ALGORITHMS AND COMPLEXITY

Teachinque and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers / Practical) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Practical, Oral presentation and viva ● Case study/Mini project **B. Semester End Examination**

REFERENCES

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, Prentice Hall India, Third Edition.
2. G. Brassard, P. Bratley, Fundamentals of Algorithms, PHI.
3. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajeshekharan, Computer Algorithms/C++, Second Edition, Universities Press.
4. A. Levitin, Introduction to Design and Analysis of Algorithms, Pearson.
5. Basu S.K., Design Methods and Analysis of Algorithms, Prentice Hall, Second Edition.
6. A. Bhargava, Grokking Algorithms: An illustrated guide for programmers and other curious people, Manning Publications.
7. A. Basheer, M. Zaghlool, FPGA-Based High Performance Parallel Computing, Scholars' Press.
8. Richard Neapolitan, Kumars Naimipour, Foundations of Algorithms, Jones and Barlett Publishers, Canada, Fourth Edition.
9. Sara Base Allen Van Gelder, Computer Algorithms: Introduction to Design and Analysis, Pearson Education Asia.

10. Prabhakar Gupta, Vineet Agarwal, Manish Varshney, Design and Analysis of Algorithms, Prentice Hall India, Second Edition.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 14 ARTIFICIAL INTELLIGENCE

SchoolName	**School of Computer Sciences**					
Programme	**M.Sc.**					
Course Name	Artificial Intelligence					
Type of Course	Core					
Course Code	**CO M 21 C 14**					
Names of Academic Staff & Qualifications	Dr. Ivy Prathap, Ph.D.					
Course Summary & Justification	Today, the amount of data that is generated by both humans and machines far outpaces human ability to absorb, interpret, and make complex decisions based on that data. Artificial intelligence forms the basis for all computer learning and is the future of all complex decision making. This course aims to introduce the basic concepts, theories, state-of-the-art techniques and applications of artificial intelligence.					
Semester	1					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	28	-	50	120
Pre-requisite	Basics of Data Structures and Algorithms					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 14 ARTIFICIAL INTELLIGENCE

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand fundamentals of Artificial Intelligence and expert systems	U	1,2,10
2	Elucidate state space and searching strategies	E	2,10
3	Analyze various types of standard search algorithms	An	3,10
4	Illustrate advanced search techniques and algorithms like minmax for game playing.	A	3,9,10
5	Examine Knowledge representation and predicate logic	A	1,10
6	Investigate the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.	E	2,10
7	Apply the machine learning concepts in real life problems.	A	1,9,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction to Artificial Intelligence: Definition of AI; Future of AI; Brief Discussion of Major Topics (Expert System, Natural Language Processing, Speech and Pattern Recognition etc.) of AI. Problem Definition as a State Space Search, Production System, Control Strategies, Problem Characteristics.	6	1,2
UNIT II	Types of search algorithms: Formal vs. Informal search: Breadth First Search, Depth First Search, iterative deepening, uniform cost search, Hill climbing and its Variations, simulated annealing, genetic algorithm search; Heuristics Search Techniques: Best First Search, A* algorithm, AO* algorithm, Min-max & game trees, refining minmax, Alpha – Beta pruning, Constraint Satisfaction Problem, Means-End Analysis.	20	3

UNIT III	Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.	16	4,5
UNIT IV	Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.	14	6
UNIT V	AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware –Perception – Planning – Moving**.**	14	7

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Oral presentation and viva

	• Case study **B. Semester End Examination**

REFERENCES

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 3rd edition, Pearson Education.
2. Elaine Rich and Kelvin Knight, Artificial Intelligence, 3rd edition, Tata McGraw Hill.
3. M. Tim Jones, Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers, First Edition.
4. Nils J. Nilsson, Artificial Intelligence: A new Synthesis, Harcourt Asia Pvt. Ltd.
5. George F. Luger, Artificial Intelligence-Structures and Strategies For Complex Problem Solving, Pearson Education.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 16 CASE STUDY USING PYTHON-LAB

School Name	School of Computer Sciences					
Programme	M.Sc.					
Course Name	Case Study using Python-Lab					
Type of Course	Core					
Course Code	SKSMPC16					
Names of Academic Staff & Qualifications	Ms. Jissy Liz Jose, M.Tech.					
Course Summary & Justification	The course provides an insight into the fundamentals of Python programming. It covers programming environment, important instructions, data representations, database connectivity and object-oriented design of Python. This course lays the foundation to develop Web applications, Machine Learning, Artificial Intelligence-based applications, Data Science and Data Visualization applications.					
Semester	I					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Assignments, Viva, Record Preparation etc.	-	14	84	22	120
Pre-requisite	Basic knowledge of any programming language concepts.					

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CO M 21 C 16 CASE STUDY USING PYTHON-LAB

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Write, test and debug Python programs in interactive mode and script mode	A	1,2,3
2	Familiarize with variables, keywords, operators, expressions, input-output, data types and functions of python.	U	1,2,3
3	Apply built in functions, modules and packages to solve real world problems.	A	1,2,3,4,7 10
4	Illustrate the uses of assignment statements, conditional and iterative statements in Python	A	1,2,3,4
5	Choose an appropriate Data Structure like Lists, Tuples, Sets and Dictionaries of Python for solving a problem.	An	1,2,3,4,7,1 0
6	Discover the capabilities of Python regular expression for data verification.	S	1,2,3,4,7,1 0
7	Interpret the concepts of Object-oriented programming in Python using polymorphism and inheritance.	E	1,2,3,4,7,1 0
8	Develop database programs and establish database connectivity using MySQL	C	1,2,3,4, 7,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Python interpreter, invoking the interpreter, arguments passing, executable python scripts, python data types, collections, input output data, built in functions.	18	1
UNIT II	Operators (unary, arithmetic, etc.) -- Data types, variables, expressions, and statements -- Assignment statements -Control Structures: loops and decision.	18	2,4

UNIT III	Modularization and Classes - Standard modules -- Packages -- Defining Classes -- Defining functions -- Functions and arguments - Exceptions and data structures -- Data Structures (array, List, Dictionary) -- Error processing -- Exception Raising and Handling.	22	3,5
UNIT IV	Regular expression in python, searching, matching, splitting, grouping string programs- Object Oriented Programming -- Object Oriented Design -- Inheritance and Polymorphism	20	6,7
UNIT V	Database programs in python-Installing MYSQL, connectivity using MYSQL, create database instance and using with python, MSQLdb module with python.	20	8

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Explicit Teaching, E-learning, Active co-operative learning, Inquiry based instruction, Authentic learning, Library work and Group discussions
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Technical skills evaluation - Correctness of programs ● Internal Tests – Minimum two (Practical) ● Assignments -Lab Records, Practical and Viva ● Case study ● **B. Semester End Examination**

REFERENCES

1. Starting out with python by Tony Gadis ,2nd edition Pearson Publications
2. Python: From Novice to Professional by Magnus Lie Hetland-Apress
3. Python 2.6 Bible –Dave Breuck and Stephen Tanner-Hungry minds Ins.
4. Beginning Python –Peter Norton,Alex Samuel, David Aitel-wrox publications
5. Python Essential Reference-David M Beazley second Edition

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CO M 21 C 16 CASE STUDY USING PYTHON-LAB

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 11 CYBER SECURITY AND CYBER LAWS

ELECTIVES

Name of School	School of Computer Sciences					
Programme	M. Sc					
Name of Course	**CYBER SECURITY AND CYBER LAWS**					
Type of Course	Elective					
Course Code	**CO M 21 E 11**					
Names of Academic Staff & Qualifications	Dr. Abdul Jabbar P, MPhil, PhD Ph. D					
Course Summary & Justification	The course is focused on the concept of cyber security and cyber law. Areas include Proxies, Tunneling technique, Fraud technique, Brute force and dictionary attacks, Cross site scripting, Social engineering and protection of information using cyber laws. Finally it concludes pointing out future development in cyber security and law. The learner is capable of using cyber space in the industry for defending attacks.					
Semester	I					
Total Student Learning Time (SLT)	**Learning Approach**	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	14	28	36	120
Pre-requisite	The learner must have gained the fundamental concepts of cyber security and information interchange.					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 11 CYBER SECURITY AND CYBER LAWS

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the significance of cyber security, cryptography and cyber laws.	R, U	1,2,10
2	Recognize and understand the characteristics of attackers technique and motivations.	A,An,S,E	3,4,5
3	Identify and compare various cyber attacks to protect information.	C,An, S, E	3,5,7,8
4	Analyse and evaluate various cyber law based infamous cyber crime(civil and criminal cybersecurity offenses)	U,A,An,E	2,8,9,10
5	Develop and update future development in cyber security law, cyber privacy and data protection law.	A,C,An,E	1,3,4,8,9
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction to Cyber Security; Information security, Fundamentals, Network and security concept; Information assurance fundamentals, Basic cryptography, Symmetric encryption, Public key encryption, firewalls and virtualization.	15	1
UNIT II	Attacker technique and motivations; Using Proxies, Tunneling technique, Fraud technique, Rogue antivirus, Click fraud, Threat infrastructure, Exploitation; Shell code, Integer overflow, Stack based buffer overflows, String vulnerabilities, SQL injection, Malicious PDF file, Race condition, Web exploit tools, DoS condition.	20	2
UNIT III	Brute force and dictionary attacks, Cross site scripting, Social engineering, WarXing, Malicious code; self replicating malicious code, Evading detection and elevating privileges, Stealing information and exploitation, Memory	15	3

	forensics, Honeypots, Malicious code naming, Intrusion detection system		
UNIT IV	Introduction to Cybersecurity law, Infamous cybercrimes, Cybercrime taxonomy, Civil vs criminal cybersecurity offenses, Basic element of criminal law, Branches of law, Tort law, Cyber law enforcement, Cybersecurity law jurisdiction, Cybercrime and cyber tort punishment.	20	4
UNIT V	Cyber privacy and data protection law; Common law of privacy, Privacy laws, Data breach laws, Data breach litigation, Privacy notice law, Personal liability, Data disposal law, Cryptography and digital forensics law, Social media privacy, Future development in cybersecurity law.	14	5

Classroom Procedure	**Mode of transaction** Direct Instruction: Brain storming lecture, Practical Session, 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers / Practical) ● Seminar – Research Literature review, Report writing, Presentation ● Assignments – Written, Practical, Oral presentation and viva ● Case study/Mini project **B. Semester End Examination**

REFERENCES

1. James Graham, Rick Howard, Ryan Olson, Cyber Security Essentials, CRC Press, 2016.
2. Mayank Bhushan, Rajkumar Singh Rathore, Aatif Jamshed, Fundamentals of Cyber Security, BPB Publications, 2017.
3. Tari Schreider, Cybersecurity Law, Standards and Regulations, 2nd Edition, Rothstein Publishing, 2020.
4. Information Resources Management Association, Cyber Law, Privacy, and Security Concepts, Methodologies, Tools, and Applications, IGI Global, 2019.
5. Jeff Kosseff, Cybersecurity Law, Wiley, 2019.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E12 ADVANCED DATA STRUCTURES

Name of School	School of Computer Sciences					
Programme	M. Sc					
Name of Course	Advanced Data Structures					
Type of Course	Elective					
Course Code	**CO M 21 E 12**					
Names of Academic Staff , Qualifications	Dr. Abdul Jabbar P, M Phil, PhD					
Course Summary , Justification	The course covers the advanced concept of the design, analysis, and implementation of data structures and algorithms to solve problems using any programming language. Areas include elementary data structures, (including arrays, stacks, queues, and lists), advanced data structures (including trees, heap and graphs), the algorithms used to manipulate these structures, and their application to solving practical problems.					
Semester	I					
Total Student Learning Time (SLT)	**Learning Approach**	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	14	28	36	120
Pre-requisite	The learner must have gained the fundamental concepts of Data Structure at bachelor level.					

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CO M 21 E12 ADVANCED DATA STRUCTURES

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Define and develop data structure concept	A,An,S,E	3,4,6
2	Construct and categorize various list such as linkedlists, Shared and Recursive Lists; Heterogeneous Lists – Deterministic Skip Lists	C,A,S ,E	4,5,8
3	Expertise in Hashing technique using construct and demonstrate Algorithms	U,A,An,C	3,6,7,9
4	Identify a problem and analyze it in terms of its significant parts and the information needed to solve using Search Structures.	A,An,S,E	3,4,6
5	Manage and develop Heap Structures in problem solving aspects.	A,C,An,E	4,8,9,10
6	Formulate and evaluate possible Algorithms of the problems, and select and measure the chosen Algorithms	S,C,E	1,3,7,9
7	Demonstrate the ability to analyze, design, apply and use data structures and algorithms to solve engineering problems and evaluate their solutions.	An,U,R,,A	5,6,7,8,9,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction to Data Structure: Overview, Types and Characteristics of Data Structure, Arrays, Stacks, Queues, Linked lists, Trees, Graphs.	15	1
UNIT II	Generalized linkedlists**,** Representation, Recursive Algorithms, Reference Counts– Shared and Recursive Lists; Heterogeneous Lists – Deterministic Skip Lists. Hashing:- Separate Chaining; Open Addressing – Linear	20	2,3

	Probing – Quadratic Probing; Double Hashing – Rehashing – Extendible Hashing.		
UNIT III	Search Structures, 2-3 Trees – 2-3-4 Trees Rd-Black Trees – B-Trees - Splay Trees – Digital Search Trees Tries – Differential Files – AA-Trees – Treaps – K Trees K-d Trees – Tries.	15	4
UNIT IV	Heap Structures, Min-Max Heaps – D-heaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Binary Heaps – Skew Heaps – Pairing Heaps – Applications.	20	5
UNIT V	Abstract Data Type (ADT) – algorithms - concepts - definition - objectives of algorithms quality of an algorithm - space complexity and time complexity of an algorithm, Sorting, Searching and Application.	14	6,7

Classroom Procedure	**Mode of transaction** Direct Instruction: Brain storming lecture, Practical Session, 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** **6.** Internal Tests – Minimum two (Extended answers / Practical) **7.** Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation **8.** Assignments – Written, Practical, Oral presentation and viva **9.** Case study/Mini project **B. Semester End Examination**

REFERENCES

1. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, Fundamentals of Data Structures in C++, 2nd Edition, Universities Press.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Second Edition, Pearson Education Asia.
3. Debashish Samanta, Classic Data Structures, PHI Second Edition.
4. Kutti, Padhye, Data Structures in C++, PHI, First Edition.
5. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Addison-Wesley.
6. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press.
7. Richard F. Gilberg and Behrouz A. Forouzan, Data Structures: A Pseudocode Approach With C, Cengage Learning.
8. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J. Augenstein, Data Structure using C, Prentice- Hall.
9. Robert Kruse, Tondo C L and Bruce Leung, Data Structures & Program Design in C, Pearson India, 2nd Edition.
10. Thomas H Cormen, Charles E Leiserson, and Ronald L Rivest, Introduction to Algorithms, 3rd Edition, Prentice Hall of India Private Limited.
11. Jean-Paul Tremblay, Paul G. Sorenson, P. G. Sorenson, Introduction to Data Structures with Applications, Mcgraw-Hill College.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E13 3D GRAPHICS

SchoolName	School of Computer Sciences					
Programme	M.Sc.					
Course Name	3D Graphics					
Type of Course	Elective					
Course Code	**CO M 21 E 13**					
Names of Academic Staff & Qualifications	Prof. Dr. Bindu V R, Ph.D					
Course Summary & Justification	Computer graphics is one of the vital aspects of any computing system. Its primary role is to render the digital content (0's and 1's) in a human-comprehensible form on the computer screen. The objective of this course is to familiarize students with fundamental algorithms and data structures that are used in today's interactive graphics systems as well as programming and architecture of high-resolution graphics computers. The students get hands on experience on graphic programming APIs such as OpenGL.					
Semester	1					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	14	28	36	120
Pre-requisite	Basics of Geometry, linear algebra, vectors and matrices					

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School of Computer Sciences

CO M 21 E13 3D GRAPHICS

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand fundamentals of 3D graphics and display methods	U	1,2
2	Elucidate 3D Geometric transformations	U, An, E	1,2,10
3	Analyze Representations of 3D Objects	An	1,3,5,10
4	Illustrate representation of solids	U, A, An, E	3,9,10
5	Compare and Analyse Visible surface detection methods.	U, A, An	1,2,3,5,10
6	Investigate types of projections and projection matrices	U, An, E	1,2,3,10
7	Create graphic programs using OpenGL	U, An, A, C, E	1,2,3,5,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction - Three dimensional Concepts, Display Methods	8	1
UNIT II	3D Geometric transformations- Translation, Scaling, Rotation, Reflection, Shear, Composite Transformations, Modeling and Co-ordinate transformations	20	2
UNIT III	Representations of 3D Objects - Polygon surfaces, Representation of curves and surfaces, Representing solids- Sweep representations, Boundary representations, Spatial-partitioning representations, Constructive solid geometry.Visible surface detection methods. Shading and Illumination.	24	3,4,5
UNIT IV	Viewing-Projections, ProjectionMatrices.	16	6

UNIT V	Discrete Techniques in OpenGL - Texture mapping, Bit and Pixel operations, Compositing, Sampling and Aliasing Techniques.	16	7

Teaching andLearningApproach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Oral presentation and viva ● Case study **B. Semester End Examination**

REFERENCES

1. Hearn D.,Baker M, P., Computer Graphics, Prentice-Hall of India.
2. Foley J,D.,Andries Van Dam, Computer Graphics - Principles and Practice, Addison-Wesley.
3. Angel, Edward. Interactive Computer Graphics- A Top-down Approach with OpenGL, Addison-Wesley.
4. F. S. Hill, Computer Graphics Using OpenGL, Pearson Education.
5. Alan Watt, 3D Computer graphics, Pearson Education.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 21 MACHINE LEARNING

SECOND SEMESTER

School Name	**School of Computer Sciences**					
Programme	**M. Sc.**					
Course Name	**Machine Learning**					
Type of Course	Core					
Course Code	**CO M 21 C 21**					
Names of Academic Staff & Qualifications	Prof. (Dr.) Anuj Mohamed, Ph. D.					
Course Summary & Justification	This course provides knowledge of techniques to design efficient machine learning algorithms to solve real-world problems. The students will learn the basic mathematical/statistical concepts required to understand and develop machine learning algorithms. The students will also get acquainted with the design and implementation of efficient algorithms to solve various real-life problems by applying the neural network approach.					
Semester	I					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments, etc.	42	14	28	36	120
Pre-requisite	Mathematical Foundations, Programming Skills					

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CO M 21 C 21 MACHINE LEARNING

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the concept of machine learning and its applications.	U, A	1,3
2	Understand and apply mathematical/statistical concepts required to develop efficient machine learning algorithms.	U, A, An	2, 3,4
3	Understand and apply the Bayesian method	U, A, An	1, 2, 3
4	Understand the concept and various techniques for prediction	U	1
5	Understand and apply the concept of linear regression to solve prediction problems	U, An, A, C	1,2,3,4
6	Understand and apply the concept of the gradient descent approach	U, A	1,2
7	Understand the concept and various techniques for classification	U	1
8	Understand and apply the concept of logistic regression to solve classification problems	U, An, A, C	1,2,3,4
9	Apply the concept of regularization in linear and logistic regression	U,An,A,E	1,2,3,8
10	Understand the concepts of Artificial Neural Networks, Multilayer Perceptrons and apply the Backpropagation algorithm for training the neural network	U,A,An, C	1,2,3,5
11	Critically analyze the efficiency of alternative algorithmic solutions for the same problem	U, An, E	1,2,8
12	Design and implement efficient algorithms to solve various real-life problems by applying neural network concepts and presenting the approach effectively with appropriate tools.	U, A, An, C,E	1,2,3,5,8
13	Acquire knowledge and skills through self-paced and self-directed learning and adapt to changing trends through knowledge/skill updation/reskilling.	U, An, A, C, E	7, 8, 10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

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School of Computer Sciences

CO M 21 C 21 MACHINE LEARNING

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction: Concept of Machine Learning, Types of Machine Learning, Challenges of Machine Learning, Applications of Machine Learning, Mathematical Foundations for Machine Learning: Linear Algebra, Analytic Geometry, Matrix Decompositions, Vector Calculus, Probability and Distributions, Continuous Optimization, Statistical Learning: Bayesian Method, The Naive Bayes Classifier.	20	1,2,3,13
UNIT II	Linear Regression: Prediction using Linear Regression, Gradient Descent, Linear Regression with one Variable, Linear Regression with Multiple Variables, Polynomial Regression, Feature Scaling/Selection.	14	4,5,13
UNIT III	Logistic Regression: Classification using Logistic Regression, Logistic Regression vs. Linear Regression, Logistic Regression with one Variable and with Multiple Variables.	14	6,7,8,9,13
UNIT IV	Regularization: Regularization and its Utility: The problem of Overfitting, Application of Regularization in Linear and Logistic Regression, Regularization and Bias/Variance.	14	11,13
UNIT V	Neural Networks: Introduction, Model Representation, Gradient Descent vs. Perceptron Training, Stochastic Gradient Descent, Multilayer Perceptrons, Multiclass Representation, Back Propagation Algorithm.	22	6,10,12,13

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CO M 21 C 21 MACHINE LEARNING

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers / Practical) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Practical, Oral presentation and viva ● Case study/Mini project **B. Semester End Examination**

REFERENCES

1. Ethem Alpaydin, "Introduction to Machine Learning", 4th Edition, The MIT Press.
2. Deisenroth, Marc Peter, et al. Mathematics for Machine Learning. Cambridge University Press.
3. Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Second Edition, Springer.
4. Christopher M. Bishop, "Pattern Recognition and Machine Learning".
5. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", The MIT Press.
6. Kevin P. Murphy, "Machine Learning, 2nd Edition, The MIT Press.
7. Dipanjan Sarkar, Raghav Bali, Tushar Sharma, Practical Machine Learning with Python, Apress
8. Yegnanarayana B, Artificial Neural Networks , Prentice-Hall India Pvt. Ltd.
9. "Mastering Machine Learning: A Step-by-Step Guide with MATLAB", MathWorks.
10. Giuseppe Ciaburro, "MATLAB for Machine Learning", Packt Publishing Limited.
11. U Dinesh Kumar, Manaranjan Pradhan, "Machine Learning using Python", Wiley.
12. Tom M. Mitchell, "Machine Learning", 1st Edition, Tata McGraw-Hill Education.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 22 DIGITAL IMAGE PROCESSING

School Name	**School of Computer Sciences**					
Programme	**M. Sc.**					
Course Name	**Digital Image Processing**					
Type of Course	Core					
Course Code	**CO M 21 C 22**					
Names of Academic Staff & Qualifications	Prof. Dr. Bindu V R, M. Sc., Ph. D.					
Course Summary & Justification	The course provides a thorough discussion on the fundamentals of digital image processing, relating these to contemporary technologies and applications. The students will get a deep understanding of digital image processing operations and can implement these operations practically through programming. They will also be made capable of applying this knowledge for practical applications.					
Semester	II					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignment, case Study etc.	42	28	42	8	120
Pre-requisite	Overview of Computer System and basic mathematics.					

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School of Computer Sciences

CO M 21 C 22 DIGITAL IMAGE PROCESSING

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Define the elements of image processing and differentiate color image models in image representation.	U, An	1
2	Compare and Analyse various spacial domain and frequency domain image transformations and filtering techniques.	An	1,2
3	Analyse and Compare various image enhancement techniques.	An	1,2,4
4	Illustrate histogram processing on an image.	A, An	1,2,3
5	Analyse and Compare various image restoration techniques.	An	1,2,4
6	Illustrate different morphological operations on an image.	A, An	1,2,3
7	Analyse and Compare various image segmentation techniques.	An	1,2,4
8	Illustrate segmentation of an image.	A, An	1,2,3
9	Develop programs implementing the different image processing operations on sample images and illustrate.	U, A	1,2,3,4
10	Discuss image recognition techniques.	U, An	1,2
11	Analyse and compare the methods for image compression.	An	1,2,4
12	Discuss, analyse and compare the latest technologies and issues in Digital Image Processing.	U, An, A, C, E	5, 7, 8, 9, 10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 22 DIGITAL IMAGE PROCESSING

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Elements of digital image processing systems, Elements of visual perception, psycho visual model, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals -RGB,HSI models, Image acquisition and sampling, Quantization, Image file formats, Two-dimensional convolution, correlation, and frequency responses.	20	1
UNIT II	Image Transforms- 1D DFT, 2D transforms – DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Radon and Wavelet Transform.	22	2,12
UNIT III	Image Enhancement and Restoration- Histogram modification and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean,Contra harmonic filters, Homomorphic filtering, Color image enhancement. Image Restoration – degradation model, Unconstrained and Constrained restoration, Inverse filtering, Wiener filtering, Geometric transformations – spatial transformations, Gray-Level interpolation.	24	2,3,4,5,12
UNIT IV	Image Segmentation and Recognition- Edge detection. Image segmentation by region growing, region splitting and merging, edge linking, Morphological operators: dilation, erosion, opening, and closing. Image Recognition – Patterns and pattern classes, matching by minimum distance classifier, Statistical Classifier. Matching by correlation, Neural network application for image recognition.	24	6,7,8,10,12

UNIT V	Image Compression- Need for image compression, Huffman, Run Length Encoding, Arithmetic coding, Vector Quantization, Block Truncation Coding. Transform Coding – DCT and Wavelet. Image compression standards.	22	9,11,12

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum Two (Extended answers / Practical) ● Seminar – ▪ Research Literature Review ▪ Report Writing ▪ Presentation ● Assignment – Written, Practical, Oral Presentation and Viva ● Case study/ Mini project **B. Semester End Examination**

REFERENCES

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson Education, Inc.
2. Scott E Umbaugh, 'Digital Image Processing and Analysis', CRC Press.
3. Anil K.Jain, 'Fundamentals of Digital Image Processing', Prentice Hall of India.
4. David Salomon : Data Compression – The Complete Reference, Springer Verlag New York Inc.
5. Rafael C. Gonzalez, Richard E.Woods, Steven Eddins, ' Digital Image Processing using MATLAB', Pearson Education.
6. William K. Pratt, ' Digital Image Processing', John Wiley, NewYork.

7. Milan Sonka, Vaclav Hlavac, Roger Boyle, 'Image Processing, Analysis, and Machine Vision', Brooks/Cole, Vikas Publishing House.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 23 DATA MINING

SchoolName	**School of Computer Sciences**					
Programme	**M. Sc.**					
Course Name	Data Mining					
Type of Course	Core					
Course Code	**CO M 21 C 23**					
Names of Academic Staff & Qualifications	Prof. Dr. Pushpalatha K P, MCA, PhD					
Course Summary & Justification	This course provides information on various data mining methodologies and techniques and is deeply related to scientific research areas. The content includes background of datamining, data warehouse schemes and operations on them, pre-processing techniques, Frequent patterns identification, information retrieval, classification, clustering, association mining, advanced techniques for classification etc. The students will be able to acquire a very broad yet in-depth knowledge and practice of the principles of data mining and data mining techniques after studying this course. It will help to improve their knowledge and intelligence in decision making process and enable them to be capable of handling jobs in R & D divisions of any company as software engineer/scientist.					
Semester	II					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	28	42	8	120
Pre-requisite	Understanding in Database Management and Statistics					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 23 DATA MINING

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the various functionalities or principles of data mining.	U	2
2	Design an efficient data warehouse model, given a data mining problem.	A, An, C	1, 2
3	Illustrate the application of various data mining functionalities such as Association rule Mining, Classification of objects, Clustering, Information retrieval, and Outlier detection.	U, R, An	2, 3
4	Implement the algorithms of the various data mining functionalities and analyse the performance of the algorithms to select the best.	A, An, C	2, 5, 8, 10
5	Demonstrate the benefits of various visualisation tools.	R, U, E	1, 2, 3, 5, 10
6	Evaluate the performance of the multiple algorithms for a specific functionality to select the best.	A, An, E	1, 2, 3
7	Research, identify and create alternate innovative and better than existing, solutions for a data mining problem.	An, A, C	2, 3, 7, 10
8	Analyse a given problem and identify which data mining functionality is the most suitable one.	An, A	1,2,5.
9	Compare the various model evaluation techniques and identify the most suitable to evaluate a new classifier.	A, C, S	3, 4, 5
10	Prepare a report and do a presentation on the comparative study of the applications of Data Mining in the domains: WWW, Spatial, Text, Image, and temporal data.	U, R, An	2, 3, 5, 8
11	Develop new clustering/classifier/outlier detection algorithms for any application, document, present and demonstrate the working of that method.	An, E, C	2, 5, 8
12	Acquire knowledge and skills through self-paced and self-directed learning and adapt to changing trends through knowledge/skill updation/reskilling.	U, An, A, C, E	7, 8, 10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 23 DATA MINING

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction to Data Mining, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining, Basic Concepts of Data Warehouse, Multitired Data Warehouse Architecture, Data Warehouse Models, Data Warehouse Modeling, Data Cube, a Multidimensional Data Model, Schemas for Multidimensional Data Models, Stars, Snowflakes, Fact Constellation Technology. Typical OLAP Operations.	20	1,2,12
UNIT II	Data Objects and Attribute Types, Basic Statistical Description of Data, Visualisation Techniques, Pixel Oriented, Geometric Projection, Icon-based, Measuring Data Similarity and Dissimilarity, Data Matrix, Dissimilarity Matrix, Measures for Nominal Attributes, Binary Attributes, Numeric Data, Ordinal Attributes, Cosine Similarity. Needs of Preprocessing the Data, Major Tasks, Data Cleaning, Data Integration, Data Reduction, Overview of Data Reduction Strategies, Principal Component Analysis, Attribute Subset Selection, Histograms, Clustering, Transformation, Overview of Transformation Strategies, Normalisation, Discretization by Histogram analysis, Cluster, Correlation Analysis.	24	1,5,12
UNIT III	Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Frequent Itemset Mining Methods, Apriori Algorithm, Mining Frequent Itemsets Using Vertical Data Formats, Generating Association Rules, Strong Rules and Weak Rules.	20	3,4,8,12

UNIT IV	Introduction to Classification, Classification by Decision Tree Induction, Attribute Selection Measures, Tree Pruning, Naïve Bayesian Classification, Concepts of : Classification by Back propagation, Lazy Learners, k-Nearest Neighbor Classifiers, An Overview of Other Classification Methods, Genetic, Fuzzy Sets, Model Evaluation and Selection, Haldout Method, Cross Validation, Boot Strap.	24	3,7,8,9,12
UNIT V	Introduction to Cluster Analysis,An Overview of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Probabilistic Model-Based Methods, Expectation-Maximisation Algorithm, Outlier Detection, Outlier Detection Methods, Introduction to Spatio-temporal Data Mining, Multimedia Data Mining, Text Mining, Mining the World Wide Web.	24	3,8,10,11,12

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers / Practical) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Practical, Oral presentation and viva ● Case study

	B. End Semester Examination

REFERENCES

1. Data Mining – Concepts and Techniques - JIAWEI HAN & MICHELINE KAMBER,ELSEVIER,3rd Edition.
2. MehmedKantardzic, Data Mining: Concepts, Models, Methods, and Algorithms, Wiley.
3. Data Mining Techniques – ARUN K PUJARI, University Press.
4. Building the DataWarehouse- W. H. Inmon, Wiley Dreamtech India Pvt. Ltd.
5. Data Warehousing in the Real World – SAM ANAHORY & DENNIS MURRAY. Pearson Edn Asia.
6. Data Warehousing Fundamentals – PAULRAJ PONNAIAH WILEY STUDENT EDITION
7. The Data Warehouse Life cycle Tool kit– RALPH KIMBALL WILEY STUDENT EDITION

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 24 SOFTWARE ENGINEERING

Name of School	School of Computer Sciences					
Programme	M. Sc					
Name of Course	**Software Engineering**					
Type of Course	**Core**					
Course Code	**CO M 21 C 24**					
Names of Academic Staff & Qualifications	Dr. Abdul Jabbar P, M Phil, PhD					
Course Summary & Justification	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. 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.					
Semester	Second Semester					
Total Student Learning Time (SLT)	**Learning Approach**	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Direct Teaching Seminar, Assignments, Self Learning etc.	42		28	 50	120
Pre-requisite	The learner must have gained the fundamental concepts of software.					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 24 SOFTWARE ENGINEERING

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Practice on Information Ethics and Software Engineering	I,R,U	1,2,10
2	Understand and formulate Software Requirement Engineering	A,An,S,E	3,4,5
3	Expertise in Object Oriented Software Design	C,A,I,S ,E	3,4,5
4	Identify design problem and analyze Software Quality Assurance	U,A,An,C,A t	3,4,5 ,8
5	Manage and develop Software using software project management	A,C,An,E	3,4
6	Formulate and evaluate possible software development process models in advance level	Ap,S,C,E	5,6,7, 3,4
7	Demonstrate the ability to analyze, design, apply and use of software requirement engineering and quality assurance in software project	U,Ap,R,I, At ,Ap	5,6,7,8,9,1 0
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S).			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Information and Computer Ethics, Software and Software Engineering, Software Development Process Models – The Waterfall Model, V-Model, Incremental Process Models, Prototyping, Spiral Model, Concurrent Models. Agile Development, Principles that Guide Practice.	10	1,6
UNIT II	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	2,7

UNIT III	Object Oriented Software Design using UML, Class Diagram, Deployment Diagram, Use case Diagram, Sequence Diagram, Communication Diagram, Activity Diagram, State Diagram.	15	3
UNIT IV	Quality Concepts, Review Techniques, Software Quality Assurance, Software Configuration Management, Product Metrics, Software Testing Strategies, Testing Conventional Applications, Testing Object-Oriented Applications, Testing Web Applications.	15	4,7
UNIT V	Project Management Concepts, Process and Project Metrics, Estimation for Software Projects, Project Scheduling, Risk Management. Searching and Application.	15	5

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers / Practical) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Practical, Oral presentation and viva ● Case study **B. End Semester Examination**

REFERENCES

1. Pressman, R.S., Software Engineering: A Practitioner's Approach, MGHISE, 7th Edition.
2. Bernd Bruegg and Allen H, Object Oriented Software Engineering Using UML, Patterns and Java, 2nd Editio.

3. Rajib Mall, Fundamentals of Software Engineering,4th Edition, PHI.
4. Anirban Basu, Software Quality Assurance, Testing and Metrics, First Edition, PHI
5. Sommerville, I., Software Engineering, Pearson Education, 7th Ed..
6. Schach, S., Software Engineering, TMH, 7th Ed..
7. Kelkar, S.A., Software Engineering: A Concise Study, PHI.
8. Hughes, B and Cotterel, M., Software Project Management, 3rd Edition, TMH.
9. Kenneth E. Himma, The Handbook of Information and Computer Ethics, Wiley.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 25 MINOR PROJECT USING ADVANCED JAVA & OBJECT ORIENTED ANALYSIS AND DESIGN

SchoolName	**School of Computer Sciences**					
Programme	**M.Sc.**					
Course Name	Minor Project using Advanced Java & Object Oriented Analysis and Design					
Type of Course	Core					
Course Code	**CO M 21 C 25**					
Names of Academic Staff & Qualifications	Dr. Ivy Prathap Ph.D.					
Course Summary & Justification	This course aims to develop a minor software project based on software engineering and object oriented concepts using Advanced Java. This course gives awareness and prompt them to keep-up the software development ethics. It enables the students to avail jobs such as software engineers (in general) and web applications developers.					
Semester	II					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Assignments, Viva, Record Preparation etc.		14	84	22	120
Pre-requisite	Core Java					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 25 MINOR PROJECT USING ADVANCED JAVA & OBJECT ORIENTED ANALYSIS AND DESIGN

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Prepare SRS, DFD, Activity diagram	U, C	1,2.3
2	Develop skill to prepare UML, Class Diagram, Deployment Diagram, Use case Diagram, Sequence Diagram, Communication Diagram, Activity Diagram and State Diagram.	U,R, A, C, S	1,2,3,4, 7,10
3	Write, test and debug Java programs using Remote Method Invocation	A, An	1,2,3
4	Familiarize with Servlet Form Processing using Java	U, R	1,2,3
5	Apply session management to real world problems.	A, C	1,2,3,4,7 10
6	Illustrate the uses of Using Database with JSP	A	1,2,3,4
7	Discover the capabilities of Struts ad Hibernate	S, C, E	1,2,3,4,7,1 0
8	Interpret the concepts of Spring framework	An, E	1,2,3,4,7,1 0
9	Develop programs using Springboot	C, A	1,2,3,4, 7,10
10	Achieve skill to develop web applications using Java	S, C	1,2,3,4, 7,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Software Engineering Concepts, Software and Software Engineering, Software Development Process Models – The Waterfall Model, V-Model, Incremental Process Models, Prototyping, Spiral Model, Concurrent Models. Software Implementation and Management process-inspection, Agile Development, Principles that Guide Practice. Object Oriented Programming Concepts, Object Oriented Software Design using UML, Class Diagram, Deployment Diagram, Use	20	1,2

	case Diagram, Sequence Diagram, Communication Diagram, Activity Diagram and State Diagram.		
UNIT II	Distributed Application using Remote Method Invocation**:** Introduction to RMI, Defining the Remote Interface, Implementing the Remote Interface, Defining the Client, Compile and Execute the Server and the Client. Java Servlets: Servlet Overview, Basic Servlet Architecture, Servlet Form Processing, Session Management, Database Management Using Servlets.	15	3,4,5
UNIT III	Java Server Pages: Basic JSP Scripting, JSP Architecture, Using JSP Scripting Elements, Implicit Objects, JSP Directives, Using Database with JSP, Java beans and their Application in JSP.	20	6
UNIT IV	Distributed Applications and Components: J2EE architecture, Enterprise Java Beans (EJB) - Application Servers-Types of Bean - Session Bean, Entity Bean and Message Driven Bean.	23	5
UNIT V	Struts and Hibernate: Overview of MVC Design, Struts, Components, Configuration files- Introduction to Hibernate, Hibernate Application, Hibernate Object Life Cycle. Spring framework: Spring Modules, Inversion of Control and Dependency injection, Web Services: SOAP, RESTful. Introduction to Springboot.	20	7,8,9, 10

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Explicit Teaching, E-learning, Active co-operative learning, Inquiry-based instruction, Authentic learning, Library work and Group discussions
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Technical skills evaluation - Correctness of programs ● Internal Tests – Minimum two (Practical) ● Assignments -Lab Records, Practical and Viva ● Case study **B. Semester End Examination**

REFERENCES

1. Budi Kurniawan, Sams, Java for the Web with Servlets, JSP, and EJB: A Developer's Guide to Scalable J2EE Solutions.
2. Karl Avedal, Professional JSP, Wrox Press, Second Edition.
3. James Holmes, The Complete Reference to Struts, Tata McGraw-Hill, Second Edition.
4. Jeff Linwood, Dave Minter, Beginning to Hibernate, Second Edition.
5. Rod Johnson, Juergen Hoeller, Alef Arendsen, Thomas R, Professional Java Development with the Spring Framework, Wiley India Pvt. Ltd..
6. Greg L. Turnquist, Learning Spring Boot, Packt Publishing.
7. https://tomcat.apache.org/
8. https://olemiss.edu/projects/servlets/
9. https://spring.io/

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 21 WIRELESS COMMUNICATION AND SENSOR NETWORKS

ELECTIVES

SchoolName	**School of Computer Sciences**					
Programme	**M.Sc.**					
Course Name	**Wireless Communication and Sensor Networks**					
Type of Course	Elective					
Course Code	**CO M 21 E 21**					
Names of Academic Staff & Qualifications	Dr. Ivy Prathap, Ph.D.					
Course Summary & Justification	Telecommunication involves transmission of information without wires, cables or any other electrical conductors within a shorter distance or across the globe. This course introduces basics of cellular concept, generations of Cellular communication, adhoc/sensor networks, Routing protocols used and Quality of Service.					
Semester	II					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	14	28	 36	120
Pre-requisite	Basics of Data Communication					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand fundamentals of Wireless communication System	U	1,2,10
2	Elucidate generation of Cellular Networks	E	2,10
3	Analyze various types of Channel Assignment Strategies	An	3,10
4	Understand adhoc/sensor networks		
5	Illustrate issues in adhoc wireless networks	A	3,9,10
6	Examine MAC protocols for adhoc wireless networks	A	1,10
7	Investigate the role of Routing Protocols for sensor network, location discovery, quality and other issues	E	2,10
8	Apply Quality of Service in energy management	A	1,9,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trends in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G), 4G and 5G networks. Wireless Local Loop (WLL), Wireless Local Area networks (WLAN), Bluetooth and Personal Area Networks.	16	1,2
UNIT II	The Cellular Concept: Hexagonal geometry cell and concept of frequency reuse, Channel Assignment Strategies, Distance to frequency reuse ratio, Handoff Strategies, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular	18	3

	System-cell splitting, Cell sectorization, Repeaters, Micro cell zone concept.		
UNIT III	Introduction to adhoc/sensor networks: Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering. MAC Protocols: Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality and other issues.	17	4,5,6,7
UNIT IV	Routing Protocols: Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.	15	8
UNIT V	QoS and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power and system power management schemes.	18	8

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation

	• Assignments – Written, Oral presentation and viva • Case study **B. Semester End Examination**

REFERENCES

1. Theodore S. Rappaport, Wireless Communication, Prentice Hall.
2. Vijay Garg, Wireless Communications and Networking, Elsevier.
3. Feng Zhao and Leonides Guibas, Wireless sensor networks, Elsevier publication.
4. Jochen Schiller, Mobile Communications, Pearson Education, 2nd Edition.
5. William Stallings, Wireless Communications and Networks, Pearson Education.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 22 CYBER PHYSICAL SYSTEMS

Name of School	School of Computer Sciences					
Programme	M. Sc					
Name of Course	**Cyber Physical Systems**					
Type of Course	Elective					
Course Code	**CO M 21 E 22**					
Names of Academic Staff & Qualifications	Dr. Abdul Jabbar P, MPhil, PhD					
Course Summary & Justification	The course covers the advanced concept of the cyber physical system. The topic covered data harvesting, various cps controls and security challenges.					
Semester	SecondSemester					
Total StudentLearningTime (SLT)	**Learning Approach**	Lecture	Tutorial	Practical	Others	Total
	Direct Teaching	42	14	28		120
	Assignments, Seminar, self study				36	
Pre-requisite	The learner must have gained the fundamental concepts of Networking					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Identify the importance of cross domain analysis and adaptive control of cyber physical system.	A,R,U	1,2,10
2	Analysis and verify various distributed consensus control for wireless CPS and communication channels of multi agent system.	A,An,S,E	3,4,5
3	Understand various CPS Control in online and optimization of CPS.	A,S ,E	2,3,4
4	Analyse and evaluate 5G MTS architecture and communication of industrial CPS	An,C,E ,A	3,4,5

5	Manage and develop cyber physical system Formulate challenges in research.	A,C,An,E	3,4,5
6	Formulate and evaluate reliable Cyber system to manage data and communication	S,C,E	1,3,4,6
7	Demonstrate the ability to analyze, design, apply and create Cyber Physical System	U,A,R,C	5,6,7,8,9,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction to CPS; Characteristics of CPS, CPS Domains, Cross-Domain Analysis, Adaptive control in CPS.	15	1,2,7
UNIT II	Distributed Consensus control for wireless CPS, Communication channels of multi agent system, Consensus control, Interaction control theory, Distributed control, Adaptive Quantization, Transmission length.	20	2,7
UNIT III	Online control and optimization of CPS, Framework,IPA, Data harvesting problems, Direct RF energy harvesting, Relayed RF energy harvesting.	15	2,3,7
UNIT IV	Industrial CPS, Communication in 5G MTS, Challenges and research trends, Network architecture for MTC, RA for MTC.	20	4,6,7
UNIT V	Data reliability challenge, Network wide programming challenges, CPS and human action, Security and privacy of CPS, Validation Verification and formal methods of CPS.	14	5,6,7

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 22 CYBER PHYSICAL SYSTEMS

Classroom Procedure	**Mode of transaction** Direct Instruction: Brain storming lecture, Practical Session, 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** **10.** Internal Tests – Minimum two (Extended answers / Practical) **11.** Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation **12.** Assignments – Written, Practical, Oral presentation and viva **13.** Case study/Mini project **B. Semester End Examination**

REFERENCES

1. Danda B. Rawat, Sabina Jeschke, Christian Brecher, Cyber-Physical Systems Foundations, Principles and Applications, Elsevier Science.
2. Glenn A. Fink, Sabina Jeschke, Security and Privacy in Cyber-Physical Systems Foundations, Principles, and Applications, Wiley.
3. Walid M. Taha, Abd-Elhamid M. Taha, Johan Thunberg, Cyber-Physical Systems: A Model-Based Approach, Springer International Publishing.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 23 DISTRIBUTED SYSTEMS AND PARALLEL COMPUTING

Name of School	School of Computer Sciences					
Programme	M. Sc					
Name of Course	**Distributed Systems and Parallel Computing**					
Type of Course	Elective					
Course Code	**CO M 21 E 23**					
Names of Academic Staff & Qualifications	Dr. Abdul Jabbar P, MPhil, PhD					
Course Summary & Justification	The course covers the advanced concept of the distributed system, cloud environment and distributed data management.					
Semester	Second Semester					
Total Student Learning Time (SLT)	**Learning Approach**	Lecture	Tutorial	Practical	Others	Total
	Direct teaching: Seminar, Assignment, Self learning	42	14	28	 36	120
Pre-requisite	The learner must have gained the fundamental concepts of Distributed System					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Recognize the architectural models, features and challenges of Distributed Systems.	A,R,U	1,2,5
2	Demonstrate and evaluate the various distributed objects communication and algorithm.	A,An,S,E	1,3,4,5
3	Exploration of characteristics and features of distributed computing in various cloud environment.	A,S ,E	2,3,4
4	Compare and analysis the parallel computing models, laws and theorems and parallel computation complexity.	An,C,E	3,4,5
5	Manage and demonstrate basic file operating system and Hadoop file system and data using HDFs.	A,C,An,E	3,4,5

6	Illustrate the applications of distributed system and parallel computing-Role to manage data.	S,C,E	1,3,4,6
7	Demonstrate the ability to design, apply and analyze distributed system and data.	U,R,An,A	5,6,7,8,9,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Characterization of distributed systems: Introduction, Examples of Distributed Systems, Resource sharing and the Web, Challenges, Architectural models, Fundamental models, Networking issues.	15	1,7
UNIT II	Distributed Objects and Remote Invocation: Communication between Distributed Objects, Remote Procedure Call, Remote Method Invocation, Request Reply Protocol. Overview of Distributed Mutual Exclusion-Central Server Algorithm and Ring-Based Algorithm, Elections-Ring based Election Algorithm.	20	2,7
UNIT III	Distributed Computing and Cloud Computing, introduction, Characteristics, Difference, History of Cloud Computing and Distributed Computing, Pros and cons, Security.	15	3,7
UNIT IV	Overview of Parallel Systems, Modeling Parallel Computation, Micro-Processor Models, Parallel Computation Complexity, Laws and Theorems of Parallel Computation, OpenCL for Massively Parallel Processors.	20	4,5,7
UNIT V	Introduction to Hadoop, Data, Data Storage and Analysis, MapReduce: Weather Dataset, Analyzing with Unix Tool, Scaling Out, Hadoop Streaming, Hadoop Pipes. Design of HDFS, Blocks, Namenodes and datanodes, Command line Interface, Basic File system Operation, Hadoop file system, Interfaces, Reading data from Hadoop URL, Reading data from FileSystem API, writing data.	14	5,6,7

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 23 DISTRIBUTED SYSTEMS AND PARALLEL COMPUTING

Classroom Procedure	**Mode of transaction** Direct Instruction: Brain storming lecture, Practical Session, 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** **14.** Internal Tests – Minimum two (Extended answers / Practical) **15.** Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation **16.** Assignments – Written, Practical, Oral presentation and viva **17.** Case study/Mini project **B. Semester End Examination**

REFERENCES

1. George Coulouris, Jean Dollimore, Tim Kindberg, Distributed Systems: Concepts and Design, Pearson Education Asia, 5th Edition.
2. Tanenbaum Andrew S. and Steen Maarten Van, Distributed Systems: Principles and Paradigms, 2nd Edition.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH.
4. Ronald L. Krutz, Russell Dean Vines, "Cloud Security – A comprehensive Guide to Secure Cloud Computing", Wiley – India.
5. M.N Rao, Cloud Computing, First Edition, PHI.
6. Das Gupta, Cloud Computing Based Projects using distributed Architecture,PHI.
7. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers.
8. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, Augus.
9. Tom White, Hadoop: The Definitive Guide, OReilly Media.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 31 THEORETICAL COMPUTER SCIENCE

THIRD SEMESTER

School Name	School of Computer Sciences					
Programme	M.Sc.					
Course Name	Theoretical Computer Science					
Type of Course	Core					
Course Code	**CO M 21 C 31**					
Names of Academic Staff & Qualifications	Ms. Jissy Liz Jose, M.Tech					
Course Summary & Justification	The course provides an insight into the foundations of automata theory through a set of abstract machines that serve as models for computation- finite automata, pushdown automata, and Turing machines and examines the relationship between these automata and formal languages. This has applications in circuit design, compiler design, search algorithms, cryptography and optimization problems in manufacturing, business, and management.					
Semester	III					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	28		38	120
Pre-requisite	Discrete Mathematics, Data Structures and Algorithms					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 31 THEORETICAL COMPUTER SCIENCE

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COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Formalize the notion of computation using "abstract computing devices" called automata	U, An,A	1,2,3
2	Understand the hierarchy of classes of automata: finite automata, pushdown automata, linear bounded automata, and Turing machines	U,An	2,3,10
3	Formalize the notion of problems via formal languages and classify them into regular, context-free, context sensitive and unrestricted languages.	U,A,An,E	1,2,3,8
4	Design finite state automata, regular grammar and regular expression for regular languages.	A,An, C	1,2,3
5	Design push-down automata and context-free grammar representations for context-free languages.	A,An,,C	1,2,3
6	Design Turing Machines for accepting recursively enumerable languages	A,An,,C	1,2,3
7	Understand the concepts of undecidability, intractable problems, DNA computing and membrane computing.	U,E	2,8
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Finite Automata: The central concept of Automata Theory, Introduction to Finite Automata, Deterministic Finite Automata, Nondeterministic Finite Automata, Finite Automata with ϵ-Transitions	14	1
UNIT II	Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions. Properties of Regular Languages: The Pumping Lemma for Regular Languages, Closure properties of Regular Languages, Decision	16	2

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	Properties of Regular Languages, Equivalence and Minimization of Automata.		
UNIT III	Context-Free Grammars and Languages: Context-Free Grammars, Parse Trees, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages.	14	2,3,4
UNIT IV	Properties of Context Free Languages: Normal Forms for Context Free Grammars, The Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages, Decision Properties of Context-Free Languages.	14	2,3,4,5
UNIT V	Turing Machines: The Turing Machine, Programming Techniques for Turing Machines, Turing Machines and Computers. Introduction to: Undecidability, Intractable Problems, DNA Computing, Membrane Computing.	12	2,3.6,7

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Oral presentation and viva. ● Case study **B. Semester End Examination**

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REFERENCES

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, Pearson, 3rd Edition.
2. Peter Linz, An Introduction to Formal Language and Automata, Jones and Bartlett Publishers, 6th Edition.
3. Kamala Krithivasan, Rama R., Introduction to Formal Languages, Automata Theory and Computation, Pearson.
4. John C. Martin, Introduction to the Languages and the Theory of Computation, Tata McGrawHill, 3rd Edition.
5. M.Sipser, Introduction to the Theory of Computation, Singapore: Brooks/Cole, Thomson Learning, 3rd Edition.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 32 DEEP LEARNING

SchoolName	**School of Computer Sciences**					
Programme	**M.Sc.**					
Course Name	Deep Learning					
Type of Course	Core					
Course Code	**CO M 21 C 32**					
Names of Academic Staff & Qualifications	Prof. (Dr.) Anuj Mohamed, Ph D					
Course Summary & Justification	This course aims to provide foundations of machine learning and deep learning, including the ability to successfully implement, apply and test relevant learning algorithms. The students will also get acquainted with the design and implementation of efficient algorithms to solve various real-life applications ranging from speech and natural language processing to machine vision and medical imaging by applying advanced deep learning technologies.					
Semester	III					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Assignments, Seminar etc.	42	28	14	 36	 120
Pre-requisite	Machine Learning & Neural Networks					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 32 DEEP LEARNING

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COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the concept of machine learning and its applications.	U, A	1,3
2	Understand and apply gradient-descent techniques to train deep neural networks.	U,An,A,E	1,2,3,8
3	Understand and apply generalization strategies	U, An, A	1,2,3
4	Understand and apply various Optimization techniques for training deep models	U, An, A	1,2,3
5	Construct and train convolutional and recurrent neural networks.	U,An,A,E	1,2,3,8
6	Understand the apply the concept of Auto encoders and Long Short Term Memory	U, An, A	1,2,3
7	Investigate Advanced Deep Learning Models and Applications	U, A, An, C,E	1,2,3,5,8,10
8	Design and implement efficient algorithms to solve various real-life problems by applying deep neural network concepts and presenting the approach effectively with appropriate tools.	U, A, An, C,E	1,2,3,5,8
9	Acquire knowledge and skills through self-paced and self-directed learning and adapt to changing trends through knowledge/skill updation/reskilling.	U, An, A, C, E	1,2,3,5,7, 8, 10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT
Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Machine Learning Review: Concept, Applications and Key Elements of Machine Learning, Machine Learning Fundamentals - Binary Classification, Regression, Generalization, Regularization. Learning Algorithms, Capacity, Overfitting and Underfitting, Hyper Parameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Building a Machine Learning Algorithm.	20	1

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UNIT II	Training Deep Neural Networks: Introduction, Back Propagation, Setup and Initialization Issues, The Vanishing and Exploding Gradient Problems, Gradient -Descent Strategies, Batch Normalization. Teaching Deep Learners to Generalize: Introduction, The Bias-Variance Trade-off, Generalization Issues in Model Tuning and Evaluation, Penalty-based Regularization, Ensemble Methods, Early Stopping, Unsupervised Pretraining, Continuation and Curriculum Learning, Parameter Sharing	22	2,3
UNIT III	Optimization for Training Deep Models: Challenges in Neural Network Optimization, Basic Algorithms: SGD and Momentum, Parameter Initialization Strategies, Adaptive Learning Rates: RMSProp, Adam. Approximate Second Order Methods: Newton, BFGS, Optimization Strategies and Meta-Algorithms, Batch Normalization, Coordinate Descent, Pretraining.	22	4,8,9
UNIT IV	Convolutional Neural Networks: Convolution Operation, Pooling Operation, Convolution-Detector-Pooling Building Block, Convolution Variants, Intuition Neural Networks.Recurrent Neural Networks: RNN Basics, Training RNNs, Bidirectional RNNs, Encoder-Decoder Architecture, Gradient Explosion and Vanishing, Gradient Clipping, Auto encoders, Long Short Term Memory	24	5,6,8,9
UNIT V	Advanced Deep Learning Models and Applications: Image Processing, Natural Language Processing, Speech Recognition, Video Analytics.	24	7,8,9

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 32 DEEP LEARNING

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Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Explicit Teaching, E-learning, Active co-operative learning, Inquiry-based instruction, Authentic learning, Library work and Group discussions
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Technical skills evaluation - Correctness of programs ● Internal Tests – Minimum two (Practical) ● Assignments -Lab Records, Practical and Viva ● Case study **B. Semester End Examination**

REFERENCES

1. Ian GoodfellowYoshuaBengio Aaron Courville, Deep Learning, The MIT Press.
2. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer.
3. Nikhil Ketkar, Deep Learning with Python: A Hands-on Introduction, Apress.
4. Li Deng, Dong Yu, Deep Learning: Methods and Applications, Foundations and Trends in Signal Processing ,Vol. 7, Nos. 3–4.
5. Sandro Skansi, “Introduction to Deep Learning from Logical calculus to Artificial Intelligence”, Springer.
6. EthemAlpaydin, "Introduction to Machine Learning", 4th Edition, The MIT Press.
7. Tom M. Mitchell, "Machine Learning", 1st Edition, Tata McGraw-Hill Education.
8. Christopher M. Bishop, "Pattern Recognition and Machine Learning".
9. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", The MIT Press.
10. Kevin P. Murphy, "Machine Learning, 2nd Edition, The MIT Press.
11. Yegnanarayana B, Artificial Neural Networks, Prentice-Hall India Pvt. Ltd.
12. “Mastering Machine Learning: A Step-by-Step Guide with MATLAB”, MathWorks.
13. Giuseppe Ciaburro, “MATLAB for Machine Learning”, Packt Publishing Limited.
14. U Dinesh Kumar, Manaranjan Pradhan, “Machine Learning using Python”, Wiley.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 33 DEEP LEARNING –LAB

SchoolName	**School of Computer Sciences**					
Programme	**M.Sc.**					
Course Name	Deep Learning – LAB					
Type of Course	Core					
Course Code	**CO M 21 C 33**					
Names of Academic Staff & Qualifications	Prof. (Dr.) Anuj Mohamed, Ph D					
Course Summary & Justification	This course aims to provide foundations of machine learning and deep learning, including the ability to successfully implement, apply and test relevant learning algorithms. The students will also get acquainted with the design and implementation of efficient algorithms to solve various real-life applications ranging from speech and natural language processing to machine vision and medical imaging by applying advanced deep learning technologies.					
Semester	III					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Assignments, Seminar etc.		14	84	22	120
Pre-requisite	Machine Learning & Neural Networks					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 33 DEEP LEARNING –LAB

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the concept of machine learning and its applications.	U, A	1,3
2	Understand and apply gradient-descent techniques to train deep neural networks.	U,An,A,E	1,2,3,8
3	Understand and apply generalization strategies	U, An, A	1,2,3
4	Understand and apply various Optimization techniques for training deep models	U, An, A	1,2,3
5	Construct and train convolutional and recurrent neural networks.	U,An,A,E	1,2,3,8
6	Understand the apply the concept of Auto encoders and Long Short Term Memory	U, An, A	1,2,3
7	Investigate Advanced Deep Learning Models and Applications	U, A, An, C,E	1,2,3,5,8,10
8	Design and implement efficient algorithms to solve various real-life problems by applying deep neural network concepts and presenting the approach effectively with appropriate tools.	U, A, An, C,E	1,2,3,5,8
9	Acquire knowledge and skills through self-paced and self-directed learning and adapt to changing trends through knowledge/skill updation/reskilling.	U, An, A, C, E	1,2,3,5,7, 8, 10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Machine Learning Review: Concept, Applications and Key Elements of Machine Learning, Machine Learning Fundamentals - Binary Classification, Regression, Generalization, Regularization.Learning Algorithms, Capacity, Overfitting and Underfitting, Hyper Parameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Building a Machine Learning Algorithm.	20	1

UNIT II	Training Deep Neural Networks: Introduction, Back Propagation, Setup and Initialization Issues, The Vanishing and Exploding Gradient Problems, Gradient -Descent Strategies, Batch Normalization. Teaching Deep Learners to Generalize: Introduction, The Bias-Variance Trade-off, Generalization Issues in Model Tuning and Evaluation, Penalty-based Regularization, Ensemble Methods, Early Stopping, Unsupervised Pretraining, Continuation and Curriculum Learning, Parameter Sharing	22	2,3
UNIT III	Optimization for Training Deep Models: Challenges in Neural Network Optimization, Basic Algorithms: SGD and Momentum, Parameter Initialization Strategies, Adaptive Learning Rates: RMSProp, Adam. Approximate Second Order Methods: Newton, BFGS, Optimization Strategies and Meta-Algorithms, Batch Normalization, Coordinate Descent, Pretraining.	22	4,8,9
UNIT IV	Convolutional Neural Networks: Convolution Operation, Pooling Operation, Convolution-Detector-Pooling Building Block, Convolution Variants, Intuition Neural Networks.Recurrent Neural Networks: RNN Basics, Training RNNs, Bidirectional RNNs, Encoder-Decoder Architecture, Gradient Explosion and Vanishing, Gradient Clipping, Auto encoders, Long Short Term Memory.	24	5,6,8,9
UNIT V	Advanced Deep Learning Models and Applications: Image Processing, Natural Language Processing, Speech Recognition, Video Analytics.	24	7,8,9

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Explicit Teaching, E-learning, Active co-operative learning, Inquiry-based instruction, Authentic learning, Library work and Group discussions
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Technical skills evaluation - Correctness of programs ● Internal Tests – Minimum two (Practical)

	● Assignments -Lab Records, Practical and Viva ● Case study **B. Semester End Examination**

REFERENCES

1. Ian Goodfellow Yoshua Bengio Aaron Courville, Deep Learning, The MIT Press.
2. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer.
3. Nikhil Ketkar, Deep Learning with Python: A Hands-on Introduction, Apress.
4. Li Deng, Dong Yu, Deep Learning: Methods and Applications, Foundations and Trends in Signal Processing ,Vol. 7, Nos. 3–4.
5. Sandro Skansi, "Introduction to Deep Learning from Logical calculus to Artificial Intelligence", Springer.
6. Ethem Alpaydin, "Introduction to Machine Learning", 4th Edition, The MIT Press.
7. Tom M. Mitchell, "Machine Learning", 1st Edition, Tata McGraw-Hill Education.
8. Christopher M. Bishop, "Pattern Recognition and Machine Learning".
9. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", The MIT Press.
10. Kevin P. Murphy, "Machine Learning, 2nd Edition, The MIT Press.
11. Yegnanarayana B, Artificial Neural Networks, Prentice-Hall India Pvt. Ltd.
12. "Mastering Machine Learning: A Step-by-Step Guide with MATLAB", MathWorks.
13. Giuseppe Ciaburro, "MATLAB for Machine Learning", Packt Publishing Limited.
14. U Dinesh Kumar, Manaranjan Pradhan, "Machine Learning using Python", Wiley.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 34 ADVANCED SOFTWARE DEVELOPMENT TOOLS –LAB

SchoolName	**School of Computer Sciences**					
Programme	**M.Sc.**					
Course Name	**Advanced Software Development Tools –Lab**					
Type of Course	Core					
Course Code	**CO M 21 C 34**					
Names of Academic Staff & Qualifications	Dr. Ivy Prathap Ph.D.					
Course Summary & Justification	This course provides an insight into Object oriented concepts in Python, Python libraries and Python for Data Science. Big data is increasingly important in today's commercial landscape. This course gives the best knowledge on the Big Data concepts. This course imparts the knowledge on how to implement basic data structure programs and Hadoop installation in different operating modes, run Hadoop commands and sample MapReduce programs to explore the HDFS on the Hadoop system.					
Semester	II					
Total Student Learning Time (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Assignments, Viva, Record Preparation etc.	-	14	42	64	120
Pre-requisite	Basic Python					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 34 ADVANCED SOFTWARE DEVELOPMENT TOOLS –LAB

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Write, test and debug Python programs using object-oriented concepts	A	1,2,3
2	Familiarize with Python libraries	U	1,2,3
3	Apply Python for Data science	A	1,2,3,4,7 10
4	Illustrate learning of data from Python	A	1,2,3,4
5	Understand the installation of Hadoop	U	1,2,3,4,7,1 0
7	Interpret the concepts of Hadoop cluster	E	1,2,3,4,7,1 0
8	Apply Hadoop to manage mining of huge data sets	A	1,2,3,4, 7,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Advanced Python: Object Oriented, OOPs concept, Class and object, Attributes, Inheritance, Overloading, Overriding, Data hiding, Operations Exception, Exception Handling, Except clause, Try - finally clause, User Defined Exceptions, Python Libraries. Introduction to Machine learning packages like NUMPY, SCIPY, PANDAS etc.	12	1,2
UNIT II	Python for Data Science: Pre-Processing of Data, Visualizing the Data, Exploratory Data Analysis, Clustering and identification of Outliers using Python, Performing Cross-Validation, Selection, and Optimization using Python, Learning from Data using Python..	12	3,4

UNIT III	Introduction to Big Data and Hadoop Ecosystem: Install, configure and run Hadoop and HDFS, HDFS JAVA API, Map reduce, Hadoop ETL, Hadoop Reporting Tools.	11	5
UNIT IV	Hadoop Environment: Setting up Hadoop Cluster and HDFS Monitoring, Pig and HIVE, Apache Spark	11	6
UNIT V	Security in Hadoop, Administering Hadoop, HDFS- Monitoring & Maintenance, Hadoop benchmarks, Hadoop in the cloud.	10	7,8

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Explicit Teaching, E-learning, Active co-operative learning, Inquiry-based instruction, Authentic learning, Library work and Group discussions
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Technical skills evaluation - Correctness of programs ● Internal Tests – Minimum two (Practical) ● Assignments -Lab Records, Practical and Viva ● Case study **B. Semester End Examination**

REFERENCES

1. Ashok Namdev Kamthane and Amit Ashok Kamthane, Programming and
2. ProblemSolving with Python, McGraw-Hill Education.
3. Irv Kalb, Learn to Program with Python, Apress.
4. Deepak Vohra, Practical Hadoop Ecosystem: A Definitive Guide to Hadoop-Related
5. Frameworks and Tools, - Apress.
6. Mayank Bhushan, Big Data and Hadoop: Learn by Example, BPB Publications.

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 34 ADVANCED SOFTWARE DEVELOPMENT TOOLS –LAB

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 31 DATA SCIENCE

ELECTIVES

School Name	School of Computer Sciences					
Programme	M.Sc.					
Course Name	Data Science					
Type of Course	Elective					
Course Code	**CO M 21 E 31**					
Names of Academic Staff & Qualifications	Ms. Jissy Liz Jose, M. Tech					
Course Summary & Justification	The course provides an insight into the data science process, statistical and machine learning techniques used in data science projects and delivering results. Data Science has emerged as a new, exciting, and fast-paced discipline that explores novel statistical, algorithmic, and implementation challenges that emerge in processing, storing, and extracting knowledge from Big Data. Data Science is widely used in various industry domains, including marketing, healthcare, finance, banking, policy work, and more.					
Semester	III					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	14	28	36	120
Pre-requisite	Basics of Algorithms, Programming, and Statistical analysis.					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 31 DATA SCIENCE

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the significance of data science and its key functionalities	U	2,10
2	Analyse the characteristics of dataset and illustrate how to load, manage, and explore data.	U, An, A	1.2,3,10
3	Choose and evaluate classification models, scoring models, probability models, ranking models and clustering models.	E	1,2,3,10
4	Compare and apply various single variable and multivariable models suitable for data science.	An, A	1,2,3,10
5	Perform preliminary statistical analysis, prediction and filtering on simple data sets using Python or R.	A, S, C	1,2,3.8,10
6	Choose techniques for effective visualization and presentation of data.	An, A	1,2,3,10
7	Perform Hadoop and Map-Reduce for data analysis.	An, A, C	1,2,3,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction to data science - Data science process, Roles in a data science project, Stages of a data science project, Applications of data science, setting expectations - Determining lower and upper bounds on model performance, Loading data - Working with data from files, Working with relational databases, Applications of data science.	17	1
UNIT II	Exploring data - Using summary statistics to spot problems, Spotting problems using graphics and visualization, Managing data - cleaning data, Sampling for modelling and validation. Choosing and evaluating models - Mapping problems to machine learning tasks, Evaluating classification models, scoring models, probability models, ranking models and clustering models. Validating models - Identifying common model	18	2,3

	problems, quantifying model soundness, Ensuring model quality, Case Studies.		
UNIT III	Single variable and multivariable models, Linear and logistic regression, unsupervised methods, Bagging, and random forests, Generalized additive models, kernel methods to increase data separation, Support vector machines.	17	4,5
UNIT IV	Delivering results - Documentation - Using comments and version control for running documentation, deploying models, producing effective presentations - Presenting results to the project sponsor, presenting model to end users and other data scientists.	16	6
UNIT V	**I**ntroduction to Big data and Distributed file system - Algorithm using Map Reduce, Understanding Map Reduce architecture, Hadoop, Writing Hadoop Map-Reduce programs, Loading data into HDFS, Executing the Map phase, Shuffling and sorting, Reducing phase execution.	16	7

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Oral presentation and viva. ● Case study **B. Semester End Examination**

REFERENCES

1. Nina Zumel, John Mount "Practical Data Science with R", Manning Publications.
2. Boris Lublinsky, Kevin T. Smith. Alexcy Yakubovich, "Professional Hadoop Solutions", Wiley.
3. Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerd, "Big Data Principles and Paradigms", Morgan Kaufmann.
4. Ervin Varga, "Practical Data Science with Python 3, Synthesizing Actionable Insights from Data".
5. Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk from The Frontline", O'Reilly.
6. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets". Cambridge University Press.
7. Tony Ojeda, Sean Patrick Murphy, Benjarnin Bengfort. Abhijit Dasgupta. "Practical Data Science Cookbook", Packt Publishing Limited.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 32 INTERNET OF THINGS AND BLOCK CHAIN TECHNOLOGIES

Name of School	School of Computer Sciences					
Programme	M. Sc					
Name of Course	**Internet of Things and Block Chain Technologies**					
Type of Course	Elective					
Course Code	**CO M 21 E 32**					
Names of Academic Staff & Qualifications	Dr. P. Abdul Jabbar, MPhil, PhD					
Course Summary & Justification	The course covers the theoretical concept of the design, Configure, and implementation of connected devices block chain. Areas include IOT, Connections, Smart Object, Smart environment and privacy issues of IOT and block chain.					
Semester	III					
Total Student Learning Time SLT	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
Direct Teaching		42	14	28		120
Assignments, Seminars etc.					36	
Pre-requisite	The learner must have gained the fundamental concepts of software.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Initiation of technical dimensions of blockchain in IOT mechanism and key issues in internet of things.	A,R,U	1,2,10
2	Understand and formulate Key Block chain techniques importance of security in decentralised application	C,S,E	3,4,5
3	Conceptualize IOT and smart object in smart environment using various IOT environment.	C,A,S ,E	3,4,5
4	Identify the security privacy issues in IOT and cloud environment.	U,An,C,A	3,4,5 ,8
5	Manage and develop secure system using IOT and Block chain.	A,C,,E	3,4
6	Formulate and evaluate remote controllable system.	S,C,E	5,6,7, 3,4

7	Demonstrate the ability to analyze, design, apply and use of various cryptography method to secure data and connected device.	U,A,E,An	5,6,7,8,9,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction to Blockchain in Internet of Things, Overview, Blockchain applicationin internet of things, Security and privacy in Internet of things, Technical dimensions of blockchain, Consensus mechanism, Key issues in internet of things, Architectures of Internet of things, Evaluation metrics of internet of things.	15	1
UNIT II	Key Blockchain concepts, Nodes, Cryptocurrency, Tockens, Cryptography, Modern encription, Public and Private keys, Hash, Ledgers, Proof of work, Proof of stake, Hyperledger, Ripple, Unearthing Etherum, Second generation application of blockchain techniques, Smart contracts, Decentralised application.	20	2
UNIT III	Internet of things concepts, Smart object and smart environment, Machines to machines communication, IoT framework, Network connectivity, Sensors, Actuator, Radio frequency identification, Middleware Technologies, Data Exchange.	15	3
UNIT IV	Security and Privacy issues in internet of things; Confidentiality, Integrity, Authentication, Privacy concerns in IoT; Identity, Location, Trajectory, Blockchain in privacy preserving cloud data storage services; Technical dimension in cloud data preserving services, Basic techniques, Threat model, Data submission, Primitiveness identification, Blockchain enabled controllable data management, System initialization, Document	20	4,6

	modification, Documents Management, User registration, Voting and counting, Use case.		
UNIT V	Quantitative analysis; Problem of interest, Programs as graph, Factors determining execution time, Execution time analysis, Security and Privacy; Cryptographic primitives, Protocol and networks security, Information flow, Identity, Blockchain Protected Identity, Blockstack, Microsoft, IBM's Trusted Identity, Blockchain and IoT, Toyota, IBM.	14	5,7

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1. Shiho Kim, Peng Zhang and Ganesh Chandra, Role of Rlockchain Technologies in IoT Applications, Academic Press, Elsevier.
2. Liehuang Zhu,Keke Gai and Meng Li, Blockchain Technology in Internet of Things, Springer International Publishing.
3. Qusay F. Hassan, Internet of Things A to Z; Technologies and Applications, Wiley.
4. Chellammal Surianarayanan, Kavita Saini, Pethuru Raj, Blockchain Technology and Applications, CRC Press.
5. Ahmed Banafa, Secure and Smart Internet of Things (IoT) Using Blockchain and Artificial Intelligence (AI), River Publishers.

Classroom Procedure	**Mode of transaction** Direct Instruction: Brain storming lecture, Practical Session, 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** **18.** Internal Tests – Minimum two (Extended answers / Practical) **19.** Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation **20.** Assignments – Written, Practical, Oral presentation and viva **21.** Case study/Mini project **B. Semester End Examination**

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 32 INTERNET OF THINGS AND BLOCK CHAIN TECHNOLOGIES

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 33 CLOUD COMPUTING

Name of School	School of Computer Sciences					
Programme	M. Sc					
Name of Course	**Cloud Computing**					
Type of Course	Elective					
Course Code	**CO M 21 E 33**					
Names of Academic Staff & Qualifications	Dr. Abdul Jabbar P, M Phil, PhD					
Course Summary & Justification	The course covers the advanced concept of the configuration, distribution and management of data and infrastructure in all services. Areas include cloud service models, security, testing, infrastructure and its configuration					
Semester	III					
Total Student Learning Time (SLT)	**Learning Approach**	Lecture	Tutorial	Practical	Others	Total
	Direct Teaching	42	14	28		120
	Assignment, Seminars etc..				36	
Pre-requisite	The learner must have gained the fundamental concepts of Cloud Computing					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Determine the importance of Cloud Computing concept in the modern computing environment.	R,U	1,2,10
2	Understand various Cloud Models and service to manage the web-based applications.	A,S,E	1,3,4,5
3	Analysis and evaluate various cloud security requirements in secure development practice.	An,S ,E	2,3,4,5
4	Expertise in secure cloud software testing practice in software quality assurance.	U,A,C,	3,4,5
5	Recognize and management of cloud computing threats in infrastructure.	A,C,E	3,4,5
6	Formulate and evaluate possible solution of the virtual machine, and select and measure the chosen cloud environment.	An,S,C,E	1,3,4,5,6

7	Demonstrate the ability to analyze, design and apply cloud infrastructure to manage data.	E,U,R,A	5,6,7,8,9,10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Cloud computing, History of Cloud Computing, Cloud service providers, Properties, Characteristics - Benefits of Cloud Computing- Cloud Storage-Cloud computing vs. Cluster computing vs. Grid computing-Role of Open Standards- Companies in the Cloud Today.	15	1,4
UNIT II	Web-Based Application, Pros and Cons of Cloud Service Development, The NIST model, Cloud Delivery Models- SaaS, Paas, Iaas, Cloud deployment models- Private cloud, public cloud, community cloud, hybrid cloud, Alternative Deployment Models- The Linthicum Model, The Jericho Cloud Cube Model.	20	. 2,4
UNIT III	Security objectives, Services, Security design principles, secure development practice, Approaches to Cloud Software Requirements Engineering.	15	3,4
UNIT IV	Secure Cloud Software Testing, Testing for SQA, Conformance, functional, Performance & security testing.	20	6
UNIT V	Threats to Infrastructure, Data and Access Control, Cloud Service Provider Risks- Back-Door, Spoofing, Man-in-the-Middle, Replay threats, TCP Hijacking, Social Engineering, Dumpster Diving, Password Guessing, Trojan Horses and Malware.	14	5,7

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 33 CLOUD COMPUTING

Classroom Procedure	**Mode of transaction** Direct Instruction: Brain storming lecture, Practical Session, 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** 1. Internal Tests – Minimum two (Extended answers / Practical) 2. Seminar – 3. Research Literature review 4. Report writing 5. Presentation 6. Assignments – Written, Practical, Oral presentation and viva 7. Case study/Mini project **B. Semester End Examination**

REFERENCES

1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH.
2. Ronald L. Krutz, Russell Dean Vines, "Cloud Security – A comprehensive Guide to Secure Cloud Computing", Wiley – India.
3. M.N Rao, Cloud Computing, First Edition, PHI.
4. Das Gupta, Cloud Computing Based Projects using distributed Architecture,PHI.
5. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers.
6. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, Augus.

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 34 FUZZY LOGIC AND NATURE INSPIRED COMPUTING

SchoolName	School of Computer Sciences					
Programme	M.Sc.					
Course Name	Fuzzy Logic and Nature Inspired Computing					
Type of Course	Elective					
Course Code	**CO M 21 E 34**					
Names of Academic Staff & Qualifications	Prof. Dr. Bindu V R, M. Sc., Ph. D.					
Course Summary & Justification	The course provides an overview of concepts in fuzzy logic and nature inspired computing. Upon completion of this course, the students will comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory. The students will also get the concepts, principles, and applications of computing, which are inspired by processes and phenomena found in nature. It offers students an opportunity to appreciate those concepts, develop new insights and methods, and turn them into practical problem-solving and modelling. Particular examples of nature-inspired computing approaches included in this course are Genetic Algorithms, Ant Colony Algorithms, Particle Swam algorithms and Artificial Bee Colony algorithms					
Semester	III					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	14	28	36	120
Pre-requisite	**Basics of Algorithms, Programming, and Statistical analysis.**					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 34 FUZZY LOGIC AND NATURE INSPIRED COMPUTING

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Comprehend the fuzzy logic and the concept of fuzziness involved in various systems.	U	2,10
2	Understand the concepts of fuzzy sets,fuzzification, defuzzification, fuzzy rules, fuzzy inference systems etc. and apply fuzzy logic control to real time system.	U, A	1.2,3,10
3	Understand the underlying nature inspired principles of Genetic Algorithms, Ant Colony Algorithms, Particle Swam algorithms and Artificial Bee Colony algorithmsand the key ideas and steps involved in it.	U,A,An	1,2,3,10
4	Compare and analyse different nature inspired computing approaches and understand the strength, weakness, and suitability and applications of each.	U,An,A,E	1,2,3,10
5	Apply nature-inspired algorithms to optimization, design and learning problems.	S,A,An	1,2,3.4,10
6	Evaluate performance of Nature inspired algorithm in context of problem solving in optimized manner	E,An	1,2,3,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Fuzzy Logic: Concepts of uncertainty and imprecision; Properties and operations on classical setsand fuzzy sets; Classical and fuzzy relations; Membership functions and its types; Fuzzification;Fuzzy rule-based systems; Defuzzification; Fuzzy propositions; Fuzzy extension principle; Fuzzyinference system,	17	1,2

	Fuzzy Logic Control Systems, Recent applications.		
UNIT II	Genetic Algorithms: Difference between traditional algorithms and Genetic Algorithm (GA); Basic concepts of GA; Working principle;Encoding methods; Fitness function; GAOperators:Reproduction, Crossover, Mutation; Convergence of GA;Detailed algorithmic steps;Adjustment of parameters; Multicriteria optimization; Solution of typical problems using geneticalgorithm; Recent applications.	18	3
UNIT III	Ant Colony Algorithms - Ant colony basics, hybrid ant system, ACO in combinatorial optimisation, variations of ACO.	17	3,4,5,6
UNIT IV	Particle Swam algorithms - particles moves, particle swarm optimization, variable length PSO, applications of PSO.	16	3,4,5,6
UNIT V	Artificial Bee Colony algorithms - ABC basics, ABC in optimisation, multi-dimensional bee colony algorithms, applications of bee algorithms, Case studies and Hybrid Systems.	16	3,4,5,6

Teaching and LearningApproach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	Mode of Assessment A. Continuous Internal Assessment (CIA) ● Internal Tests – Minimum two (Extended answers) ● Seminar – ▪ Research Literature review

	▪ Report writing ▪ Presentation ● Assignments – Written, Oral presentation and viva. ● Case study B. Semester End Examination

REFERENCES

1. D. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning,Addison-Wesley.
2. S. Rajasekaran and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, PHI.
3. S. N. Sivanandam and S. N. Deepa, Principles of Soft Computing, 2nd ed., Wiley India.
4. J. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House.
5. G. Klir, B. Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Pearson.
6. John Yen, Reza Langari, Fuzzy Logic –Intelligence, Control and Information, PearsonEducation.
7. Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer.
8. Floreano, D. and C. Mattiussi, "Bio-Inspired Artificial Intelligence: Theories, Methods,and Technologies", MIT Press.
9. Leandro Nunes de Castro, "Fundamentals of Natural Computing, Basic Concepts,Algorithms and Applications" Chapman & Hall/ CRC, Taylor and Francis Group.
10. Marco Dorrigo, Thomas Stutzle -" Ant Colony Optimization", Prentice Hall of India,New Delhi.

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School of Computer Sciences

CO M 21 E 34 FUZZY LOGIC AND NATURE INSPIRED COMPUTING

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 35 NATURAL LANGUAGE PROCESSING

School Name	School of Computer Sciences					
Programme	M.Sc.					
Course Name	Natural Language Processing					
Type of Course	Elective					
Course Code	**CO M 21 E 35**					
Names of Academic Staff & Qualifications	Prof. (Dr.) Pushpalatha K P, PhD					
Course Summary & Justification	The course provides an insight into the principles and methodological introduction to the most widely used and effective strategies for natural language processing. The course examines various NLP models and algorithms, text retrieval strategies, exploratory analysis, text summarization and text generation techniques. NLP has applications in many domains such as computer science, journalism, social science, psychology, political science etc. where processing of text data is crucial.					
Semester	III					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	14	28	 36	120
Pre-requisite	Basics of Algorithms and Statistical analysis.					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 35 NATURAL LANGUAGE PROCESSING

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the fundamental concepts and steps of natural language processing.	U	2,10
2	Distinguish among the various NLP techniques, considering the assumptions, strengths, and weaknesses of each	U, An, E	1,2,10
3	Apply preliminary pre-processing on text data, extract features and tokenize it.	A, An, C	1,2,3,10
4	Develop a text classifier using machine learning algorithms - select appropriate model and analyse its performance.	R, U, C, E	1,2,3,10
5	Apply various text retrieval methods and analyse large volume of text data generated	A, An	1,2,3,10
6	Compare various text summarization and text generation methods	An, E	1,2,10
7	Use NLP methods to analyze sentiment of a text document	A, An, C	1,2,3,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction to Natural Language Processing, History of NPL, Text Analytics and NLP, Various Steps in NLP, Tokenization, POS tagging, Stop word removal, Text normalisation, Spelling Correction, Stemming, Lemmatization, NER, Word Sense Disambiguation, Sentence Boundary Detection, Data Collection, Preprocessing.	**16**	**1**
UNIT II	Basic Feature Extraction Methods, Introduction, Types of Data, Cleaning Text Data, Tokenizing Texts with Different Packages – Keras and TextBlob, Types of Tokenizers, Stemming,	**22**	**2, 3**

	Lemmatization, Singularizing and Pluralizing Words, Language Translation.		
UNIT III	Developing a Text classifier, Machine Learning, Various Clustering Algorithms, K-Means Clustering, Supervised Learning, Various Classifiers, Regression, Tree Methods, Sampling, Dimensionality Reduction, Deciding on a Model Type, Performance of a model, Saving and Loading Models.	**26**	**4**
UNIT IV	Collecting Text Data from the Web, Collecting Data by Scraping Web Pages, Requesting Content from Web Pages, Dealing with Semi-Structured Data, Dealing with Online JSON Files, XML Files, Using APIs to Retrieve Real-Time Data, Topic Modelling, Exploratory Data Analysis, Bag of Words, Modelling Algorithms, Latent Semantic Analysis, Latent Dirichlet Allocation, Topic Fingerprinting.	**26**	**3,4,5**
UNIT V	Text Summarisation and Text Generation, Introduction, Extractive Text Summarisation, Abstractive Text Summarisation, Summarizing Text using Gensim, Word Frequency, Generating Text with Markov Chains, Vector Representation, Encoding, Positional Character Level Encoding, One-Hot Encoding, Word-Level One Hot Encoding, Word Embeddings, Word2Vec, Using Pre-trained Word Vectors, Document Vectors Sentiment Analysis, Types of Sentiments, Applications, Tools, Python NLP Libraries, Understanding Data for Sentiment Analysis, Training Sentiment Models.	**22**	**2, 6, 7**

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 35 NATURAL LANGUAGE PROCESSING

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Oral presentation and viva. ● Case study **B. Semester End Examination**

REFERENCES

1. Dwight Gunning: Sohom Ghosh, Natural Language Processing fundamentals, Packt Publishing.
2. Palash Goyal and Sumit Pandey, Deep Learning for Natural Language Processing: Creating Neural Networks with Python, Apress.
3. Steven Bird, Ewan Klein, Edward Loper, *Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit* (O'Reilly, website 2018) http://www.nltk.org/book/
4. Dipanjan Sarkar, *Text Analytics with Python* (Apress/Springer) https://link-springer-com.proxy.uchicago.edu/book/10.1007%2F978-1-4842-2388-8
5. Stanford University CS224n: Natural Language Processing with Deep Learning http://web.stanford.edu/class/cs224n/
6. Paul Vierthaler's Stylometric PCA and Network Data Explorer https://www.pvierth.com/pca

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 36 DIGITAL SIGNAL PROCESSING AND SPEECH TECHNOLOGIES

SchoolName	**School of Computer Sciences**					
Programme	**M. Sc.**					
Course Name	**Digital Signal Processing and Speech Technologies**					
Type of Course	Elective					
Course Code	**CO M 21 E 36**					
Names of Academic Staff & Qualifications	Prof. (Dr.) Anuj Mohamed Ph. D.					
Course Summary & Justification	This course covers the concepts and techniques of modern digital signal processing which are fundamental to all the signal/speech processing, applications.The students will learn the basic concepts required to design and develop efficient speech/speaker recognition systems.					
Semester	III					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments, etc.	42	14	28	36	120
Pre-requisite	Mathematical Foundations, Programming Skills					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 36 DIGITAL SIGNAL PROCESSING AND SPEECH TECHNOLOGIES

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Understand the basic concepts of speech and fundamental signal processing approaches to speech spectral analysis.	U, A	1,3
2	Analyze various features of speech and understand the techniques of extracting the features and pattern comparison techniques.	U, A, An	2, 3,4
3	Understand statistical modeling using Hidden Markov Models and their implementation issues.	U, A, An,C	1, 2, 3,4
4	Apply Viterbi Search and Baum-Welch algorithms	U,An,A,E	1,2,3,8
5	Understand the architecture and various models of continuous speech recognition system	U, An, A, C	1,2,3,4
6	Design and development speech and speaker recognition systems	U, An, A, C,E	1,2,3,4,8
7	Apply methods of text to speech synthesis for different applications.	U,An,A	1,2,3
8	Design and implement emotion recognition systems	U, An, A, C,E	1,2,3,4,8
9	Design and implement efficient algorithms to solve various speech related problems and presenting the approach effectively with appropriate tools.	U, A, An, C,E	1,2,3,5,8
10	Acquire knowledge and skills through self-paced and self-directed learning and adapt to changing trends through knowledge/skill updation/reskilling.	U, An, A, C, E	7, 8, 10

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

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction: Fundamentals of Speech, The Human Speech Production Mechanism, LTI Model for Speech Production, Nature of the Speech Signal, Linear Time-Varying	18	

	Model, Phonetics, Types of Speech, Voiced and Unvoiced Decision Making, Audio File Formats: Nature of the WAV File. Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics, Acoustics of speech production; Review of Digital Signal Processing concepts; ShortTime Fourier Transform, Filter-Bank and LPC Methods.		1,10
UNIT II	Pitch and Formants, Fundamental Frequency or Pitch Frequency, Parallel Processing Approach for Calculation of Pitch Frequency, Pitch Period Measurement, Formants and Their Relation With LPC, Evaluation of Formants, Estimation of Formants. Homomorphic Processing, Cepstral Analysis of Speech: Cepstral Coefficients, The Auditory System as a Filter Bank, Mel Frequency Cepstral Coefficients, Perceptual Linear Prediction, Log Frequency Power Coefficients, RelAtive SpecTrAl Perceptual Linear Prediction, Short-Time Spectral Analysis of Speech, Wavelet Transform Analysis of Speech.	16	2,9,10
UNIT III	Hidden Markov Models: Markov Processes, HMMs, Evaluation, Optimal State Sequence, Viterbi Search, Baum-Welch Parameter Re-estimation; Implementation issues.	14	3,4,9,10
UNIT IV	Speech Recognition Systems, Architecture of a Large Vocabulary Continuous Speech Recognition System, Deterministic and Statistical sequence Recognition for ASR, Statistical Pattern Recognition and Parameter Estimation, VQ-HMM-Based Speech Recognition, Discriminant Acoustic Probability Estimation, Word Spotting/Keyword Spotting, Speech Recognition and Understanding, Speaker Recognition, Speech Enhancement, Adaptive Echo Cancellation.	18	5,6,9,10
UNIT V	A Text-to-Speech System, Synthesizer Technologies, Speech Synthesis Using Other Methods, Speech Transformations, Emotion Recognition from Speech, Watermarking for Authentication of a Speech/Music Signal.	18	7,8,10

Teachinque and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers / Practical) ● Seminar – ▪ Research Literature review ▪ Report writing ▪ Presentation ● Assignments – Written, Practical, Oral presentation and viva ● Case study/Mini project **B. Semester End Examination**

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1. S.D Apte, Speech and Audio Processing, Wiley India Edition.
2. Rabiner Lawrence R., and Biing-Hwang Juang, Fundamentals of Speech Recognition, Prentice Hall International.
3. D. Jurafsky and J. Martin, Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education.
4. Gold Ben, Nelson Morgan, and Dan Ellis, Speech and Audio Signal Processing: Processing and Perception of Speech and Music, John Wiley & Sons.
5. Benesty Jacob, M. Mohan Sondhi, and Yiteng Huang, Handbook of speech processing, Springer.
6. Katagiri S., Handbook of Neural Networks for Speech Processing, Artech House, Boston.
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8. A.V. Oppenheim, R. W. Schaffer, Discrete Time Signal Processing, Prentice Hall of India, New Delhi.
9. Andreas Antoniou, Digital Signal Processing, Tata McGraw Hill, NewDelhi.
10. M. H. Hayes, Schaums Outlines of Digital Signal Processing, Tata McGraw Hill, India.

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 E 36 DIGITAL SIGNAL PROCESSING AND SPEECH TECHNOLOGIES

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MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 C 41 MAIN PROJECT & COMPREHENSIVE VIVA-VOCE

FOURTH SEMESTER

School Name	School of Computer Sciences					
Programme	M.Sc.					
Course Name	Main Project & Comprehensive Viva-voce					
Type of Course	Core					
Course Code	**CO M 21 C 41**					
Names of Academic Staff & Qualifications	Dr. Pushpalatha K P, PhD					
Course Summary & Justification	The course is meant for developing software/algorithms based on innovative ideas, applying all the knowledge and skills they acquired during the previous three semesters. At the end of the course, their practical knowledge, skills and ability in designing and developing software with new objectives are evaluated. This course also gives them an opportunity to understand what their strengths and weakness in the skills they were expected to be experts. This also improves their confidence in working in any research and development environment. The students are benefited in growing a confidence in attending technical interviews for job opportunities in any R&D divisions of any industry or in educational institutions. This course gives them training and confidence in working in any real time research and development environment. The students are benefited in increasing job opportunities in any R&D divisions of any industry or in educational institutions.The course is aimed to evaluate the theoretical and practical knowledge they acquired in all the previous semesters of the programme.						
Semester	IV					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Self Practicing					120
Pre-requisite	Knowledge and practical experience in developing software using various IT technologies.					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 O 31 FUNDAMENTALS OF PROGRAMMING

School Name	School of Computer Sciences					
Programme	M.Sc.					
Course Name	**Fundamentals of Programming**					
Type of Course	Open					
Course Code	**CO M 21 O 31**					
Names of Academic Staff & Qualifications	Ms. Jissy Liz Jose, M. Tech					
Course Summary & Justification	The course provides an insight into the basics of problem-solving techniques, object-oriented programming (C++), Open-Source Software (Linux), programming in Python and documentation & presentation tools. The course is fundamental in nearly any computer programming so that these concepts help to create computer applications that can be used to solve real-world problems.					
Semester	III					
Total StudentLearningTime (SLT)	Learning Approach	Lecture	Tutorial	Practical	Others	Total Learning Hours
	Explicit Teaching Seminar, Assignments etc.	42	14	28	36	120
Pre-requisite	Nil					

MAHATMA GANDHI UNIVERSITY
School of Computer Sciences

CO M 21 O 31 FUNDAMENTALS OF PROGRAMMING

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
1	Acquire fundamental knowledge in machine language programming, assembly language programming and high-level language programming along with problem solving techniques and analytical thinking.	A	1,2,3,4,10
2	Understand fundamental programming concepts and methodologies that are essential to build good high level language programs in C++ and Python.	U	1,2,3,10
3	Apply the concepts of object-oriented programming for solving real world problems.	R, A, An, C	1,2,3,4,10
4	Design, implement, test and debug programs in C++	C, An, E	1,2,3,4,6,8,10
5	Familiarise with open-source software like Linux, use Linux commands to manage files and directories and develop shell programs.	U, A	1,2,3,4,6,10
6	Design, implement, test and debug programs in Python	C, An, E	1,2,3,4,6,8,10
7	Work with various documentation and presentation tools	U, A, C	1,2,3,4,9,10
Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S)			

COURSE CONTENT

Content for Classroom transaction (Sub-units)

Unit	Course description	Hrs	CO No.
UNIT I	Introduction to Problem Solving, Steps for Problem Solving, Machine Language Programming, Assembly Language	15	1

	Programming, High Level Language Programming.		
UNIT II	Basics of Object-Oriented Programming & C++, Introduction to Object Oriented Programming (OOP), Procedural vs. Object oriented programming, Concepts of OOP, Benefits and applications of OOP. Overview of C++, Program structure, Identifiers, Variables, Constants, enum, Data Types, Operators and Control Structures, Functions-declaration and definition, Arrays & Strings, Basics of Object & Classes, Member functions, Private and Public members, Scope resolution operator, Concept of inheritance, types of inheritance: single, multiple, multilevel, hierarchical, hybrid, protected members.	18	2,3,4
UNIT III	Concept of open-source software – GNU/Linux – Different distribution of Linux - Features of Linux, Advantages - Linux Architecture- Linux directory commands - Linux File commands - Shell Programming- Comparison of Windows and Linux operating systems.	18	5
UNIT IV	History- Features in python- Working with python- Basic syntax-variables and data types-Operators-Conditional statements- Loops-Functions-Lists & Dictionaries- Modules.	18	6
UNIT V	Documentation and Presentation Tools.	15	7

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** 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.
Assessment Types	**Mode of Assessment** **A. Continuous Internal Assessment (CIA)** ● Internal Tests – Minimum two (Extended answers) ● Seminar – ▪ Research Literature review ▪ Report writing

	▪ Presentation ● Assignments – Written, Oral presentation and viva. ● Case study **B. Semester End Examination**

REFERENCES

1. Robert Lafore, "Object Oriented Programming in C++", McGraw Hill
2. Bjarne Stroustrup, "The C++ Programming Language", Addison Wesley
3. Christopher Negus, "Linux Bible", Wiley India Edition
4. Richard Blum & Christine Bresnahan, "Linux Command Line and Shell Scripting", Wiley
5. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd
6. Peter Norton & Alex Samuel, "Beginning Python", David Aitel-wrox publications

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