THE MAHATMA GANDHI UNIVERSITY

UNDER GRADUATE PROGRAMMES (HONOURS)

SYLLABUS

MGU-UGP (Honours)

(2026 Admission Onwards)

Faculty	**Technology and Applied Sciences**
Expert Committee	**Artificial Intelligence (PG)**
Programme	**Bachelor of Science (Honours) Artificial Intelligence and Data Science**

Mahatma Gandhi University
Priyadarshini Hills
Kottayam – 686560, Kerala, India

PREFACE

The MAHATMA GANDHI UNIVERSITY UNDERGRADUATE PROGRAMME (HONOURS), MGU-UGP(Honours), is a four year under graduate programme (FYUGP) in education. FYUGP curriculum comprises Foundation Components, Discipline Specific Pathway Components (Major/ Minor), and Discipline Specific Capstone Components. The rapid advancements in Artificial Intelligence (AI) and Data Science are redefining the future of technology, business, healthcare, communication, and governance. With the growing reliance on data-driven decision-making and intelligent systems, the demand for skilled professionals in these domains has reached unprecedented levels.

The B.Sc. (Hons) Artificial Intelligence and Data Science programme has been designed as a four-year undergraduate degree that blends strong theoretical foundations with hands-on practical experience. The curriculum aims to provide students with a holistic understanding of mathematics, statistics, computer science, machine learning, deep learning, big data technologies, and AI-driven applications, ensuring they are well-prepared for both industry roles and higher research.

This programme emphasizes not only technical proficiency but also ethical considerations, critical thinking, problem-solving, and innovation, preparing graduates to contribute responsibly to the digital future. Students will engage in real-world projects, internships, and research opportunities, enabling them to bridge the gap between academic knowledge and industrial practices.

The course is structured in a progressive manner—beginning with core foundations in programming, data structures, probability, and linear algebra, moving towards advanced subjects like neural networks, natural language processing, computer vision, and data security. Interdisciplinary modules and elective courses allow learners to tailor their education to their interests, while skill enhancement courses nurture entrepreneurship, communication, and leadership qualities.

By the end of this four-year programme, students will be equipped to pursue careers as AI engineers, data scientists, machine learning specialists, business analysts, and research scholars, or to embark on entrepreneurial ventures in the emerging tech landscape.

SYLLABUS INDEX

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

SEMESTER: I

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG1DSCADS100	Fundamentals of Digital Logic and Computer Organization	DSC A	4	5	3	-	2	-
MG1MDCADS100	Computer Essentials	MDC	3	4	2	-	2	-

L — Lecture, T — Tutorial, P — Practical/Practicum , O — Others

SEMESTER: II

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG2DSCADS100	Programming using Python	DSC A	4	5	3	-	2	-
MG2MDCADS100	Office Automation	MDC	3	4	2	-	2	-

SEMESTER: III

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MG3DSCADS200	Data Structures and Algorithms Using C++		DSC A	4	5	3	-	2	-
MG3DSCADS201	Introduction to Artificial Intelligence and Data Science		DSC A	4	5	3	-	2	-
MG3DSEADS200	Computer Security(System Security Specialization)	**Any One**	DSE	4	4	4	-	-	-
MG3DSEADS201	Basics of Robotics (Robotics Specialization)		DSE	4	4	4	-	-	-
MG3DSEADS202	Introduction to IOT and its applications (Internet of Things Specialization)		DSE	4	4	4	-	-	-
MG3DSCADS202	Digital Interface Design		DSC B (Minor for Others)	4	5	3	-	2	-
	Kerala Specific Content		MDC	3	3	3	-	-	-
MG3VACADS200	Environmental Sustainability and Human Rights		VAC	3	3	3	-	-	-

SEMESTER: IV

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours / week	Hour Distribution /week			
						L	T	P	O
MG4DSCADS200	Operating Systems		DSC A	4	4	4	-	-	-
MG4DSCADS201	Database Management Systems and Security		DSC A	4	5	3	-	2	-
MG4DSEADS200	Biometric Security (System Security Specialization)	**Any one**	DSE	4	4	4	-	-	-
MG4DSEADS201	Robot Operating System (Robotics Specialization)		DSE	4	4	4	-	-	-
MG4DSEADS202	IoT Architecture and Protocols (Internet of Things Specialization)		DSE	4	4	4	-	-	-
MG4DSCADS202	Front End development		DSC B (Minor for Others)	4	5	3	-	2	-
MG4SECADS200	Data Analysis Using Spreadsheet		SEC	3	4	2	-	2	-
MG4VACADS200	Ethical Hacking		VAC	3	3	3	-	-	-
MG4INTADS200	Internship		INT	2					

SEMESTER: V

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MG5DSCADS300	Computer Networks		DSC A	4	4	4	-	-	-
MG5DSCADS301	Probability and Inferential Statistics		DSC A	4	4	4	-	-	-
MG5DSEADS300	Mobile and Wireless Security (System Security Specialization)	**Any one**	DSE	4	4	4	-	-	-
MG5DSEADS301	Embedded Robotics (Robotics Specialization)		DSE	4	4	4	-	-	-
MG5DSEADS302	IoT Storage - Cloud Computing (Internet of Things Specialization)		DSE	4	4	4	-	-	-
MG5DSEADS303	Augmented Reality and Virtual Reality	**Any Two**	DSE	4	4	4	-	-	-
MG5DSEADS304	Data Mining and Data warehousing		DSE	4	4	4	-	-	-
MG5DSEADS305	Digital Image Processing		DSE	4	4	4	-	-	-
MG5SECADS300	Software Development Lab 1 - Mini Project		SEC	3	5	1	-	4	-

SEMESTER: VI

Course Code	Title of the Course		Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
						L	T	P	O
MG6DSCADS300	Programming with R		DSC A	4	5	3	-	2	-
MG6DSCADS301	Machine Learning Techniques		DSC A	4	5	3	-	2	-
MG6DSEADS300	Security Threats and Assessment (System Security Specialization)	**Any one**	DSE	4	4	4	-	-	-
MG6DSEADS301	Robot Cognition and Navigation (Robotics Specialization)		DSE	4	4	4	-	-	-
MG6DSEADS302	Industrial IoT (Internet of Things Specialization)		DSE	4	4	4	-	-	-
MG6DSEADS303	Generative AI		DSE	4	4	4	-	-	-
MG6DSEADS304	Big Data Analysis	**Any one**	DSE	4	4	4	-	-	-
MG6DSEADS305	Applied Cryptography		DSE	4	4	4	-	-	-
MG6SECADS300	Data Visualization Tools		SEC	3	4	2	-	2	-
MG6VACADS300	AI Ethics and Governance		VAC	3	3	3	-	-	-

SEMESTER: VII

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG7DCCADS400	Deep Learning Techniques	DCC	4	5	3	-	2	-
MG7DCCADS401	Computer Vision	DCC	4	4	4	-	-	-
MG7DCCADS402	Reinforcement Learning	DCC	4	4	4	-	-	-
MG7DCEADS400	Digital Marketing	DCE	4	4	4	-	-	-
MG7DCEADS401	Technical Documentation	DCE	4	4	4	-	-	-
MG7DCEADS402	Mobile Application Development – Android	DCE	4	4	4	-	-	-

SEMESTER: VIII

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours/ week	Hour Distribution /week			
					L	T	P	O
MG8DCCADS400	**Applied Optimization in Computing**	**DCC**	**4**	**5**	**3**	**-**	**2**	**-**
MG8DCCADS401	**Risk Assessment**	**DCC**	**4**	**5**	**3**	**-**	**2**	**-**
MG8DCEADS400	Block chain	DCE	4	5	3	-	2	-
MG8DCEADS401	Natural Language Processing	DCE	4	5	3	-	2	-
MG8DCEADS402	Pattern Recognition	DCE	4	5	3	-	2	-
	OR							
MG8DCEADS403	Research Methodology in AI and Data Science	DCE	4	5	3	-	2	-
MG8DCEADS404	Publication Ethics and Documentation	DCE	4	5	3	-	2	-
MG8DCEADS405	Statistical Analysis of Research Data and Implementation Tools	DCE	4	5	3	-	2	-
	OR							
MG8PRJADS400	Project / Dissertation	PRJ	12					

SEMESTER I

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Fundamentals of Digital Logic and Computer Organization**					
Type of Course	**DSC A**					
Course Code	**MG1DSCADS100**					
Course Level	**100 – 199**					
Course Summary	To Provide a comprehensive understanding of computer system architecture, covering CPU and memory organization, instruction execution, and assembly language programming to develop foundational skills in computer organization and low-level programming.					
Semester	**I**	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	**0**	1		**75**
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand and apply various number systems including decimal, binary, octal, and hexadecimal, perform conversions between them, and carry out binary arithmetic operations such as addition and subtraction using 1's complement and 2's complement methods.	U	1, 2
2	Analyse sequential logic circuits such as flip-flops, registers, and shift registers, and explain basic computer organization including functional units, instruction cycle, CPU operations, and addressing modes.	An	1, 2
3	Understand different types of instructions such as data transfer, data manipulation, and program control, and explain memory organization including memory hierarchy, main memory (RAM and ROM), auxiliary memory, associative memory, and cache memory.	U	1, 2
CO4	Implement and verify basic digital circuits such as logic gates, adders, decoders, multiplexers, and demultiplexers etc...	A	2, 1

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Number Systems, Decimal, Binary, Octal and Hexadecimal), Conversion-From one number system to another, Concept of binary addition and subtraction- 1's Complement, 2'scomplement, Subtraction using 1's and 2's Complement BCD numbers- concept and addition	4	1
	1.2	Logic gates- AND, OR, NOT, NAND, NOR, XOR and XNOR. Truth tables - Basic laws of Boolean Algebra, Simplification of Expressions, DE Morgan's theorems	5	1
	1.3	Combinational Logic Circuits : Adders-Half adder, Full adder - Encoders- Decoders- Multiplexers – Demultiplexers	4	1
2	2.1	Sequential - Logic Circuits: Flip flops- Latch, Clocked, RS, JK, T, D, Triggering of flip flops, Master JK Slave flip flop.	6	2
	2.2	Basic Computer Organization and Design: Functional Units, Basic Operational Concepts. Instruction codes, stored program organization, Computer Registers.	6	2
	2.3	Common Bus system, Computer Instructions, Timing and Control, Instruction cycle Central Processing Unit: Introduction, General Register Organization, Stack Organization. Instruction Format, Addressing Modes.	5	2
3	3.1	Instruction Classification: Data Transfer and Data Manipulation, and Program Control instructions.	5	3
	3.2	Memory Organization: Memory Hierarchy, Main Memory- RAM and ROM chips.	5	3
	3.3	Auxiliary memory, Cache memory (Associative, Direct, Set associative mapping).	5	3
4	4.1	1.Familiarization of logic gates and verification of truth tables 2. Implementation of a logic equation using gates. 3. Verification of DE Morgan's Theorem 4. Implementation of logic gates using universal gates 5.Implementation of Half Adder 6. Implementation of Full Adder 7. Implementation of 3 to 8 decoder 8. Implementation of seven segment display. 9. Implementation of 8:1 multiplexer 10. Implementation of 1:8 demultiplexer 11. Implementation of 8 :3 encoder	30	4

		12. Verification of flip flop ICs. 13. Implementation of SR flip-flop using logic gates. 14. Implementation of shift operation using flip flops. 15. Implementation of 2 bit synchronous counter.		
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1. Digital Fundamentals,Thomas L Floyd,PEARSON Prentice Hall-Ninth Edition
2. Computer Systems Architecture, M.Morris Mano-Third Edition, Pearson Education
3. Introduction on Computers Peter Norton, Sixth Edition, 2008, TataMcGraw Hill
4. Computer Organization- Hamacher VranesicZaky, Fifth Edition, 2011, Tata McGrawHill
5. Computer Fundamentals, P K Sinha & Priti Sinha, Fourth Edition, Reprint 2018, BPB Publications

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**COMPUTER ESSENTIALS**					
Type of Course	**MDC**					
Course Code	**MG1MDCADS100**					
Course Level	**100-199**					
Course Summary	To Introduce the fundamental concepts of computer systems, hardware components, operating systems, and networks, while developing students' analytical and practical skills through hands-on understanding and application.					
Semester	**I**	Credits			**3**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the basic structure and functioning of a computer system and describe the stages of the information processing cycle, Identify and explain the functions of essential computer hardware components, Study of different types operating systems	U	1, 2, 10
2	Identify and explain the functions of essential computer hardware components, Study of different types operating systems	U	1, 2
3	Describe common output devices and explain the basics of computer networks, including their types and applications.	An	2, 3, 9

4	Demonstrate the ability to identify physical components of a computer system and perform safe disassembly and reassembly procedures effectively.	A	2, 10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	The Parts of a Computer System, The Information Processing Cycle	4	1
	1.2	Essential Computer Hardware	4	1
	1.3	System Software, Application Software	2	1
2	2.1	Input Devices – Keyboard, Mouse	3	2
	2.2	Types of Storage Devices- Magnetic Storage Devices, Optical Storage Devices, Solid-State Storage Devices	3	2
	2.3	Types of Operating Systems- Real-Time Operating Systems, Single-User/Single-Tasking Operating Systems, Single-User/Multitasking Operating Systems, Multi-User/Multitasking Operating Systems	4	2
3	3.1	Output Devices- Monitors, Commonly Used Printers	5	3
	3.2	Networking Basics- The Uses of a Network, Common Types of Networks- (LANs, WANs, Hybrid Networks, CANs, MANs, HANs, Intranets and Extranets)	5	3
4	4.1	Identify hardware components of computer (Motherboard, CPU, RAM, HDD/SSD, Power Supply, GPU, Cooling System, Case)	15	4
	4.2	Disassembly & Reassembly Remove RAM, CPU, power supply, etc. Reinstall components and verify everything works.	15	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 15 Marks** **Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **<u>Written Test - 35 Marks - Duration 1 Hour</u>** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 15 Marks(Answer any 3 questions out of 4) 3x5 = 15 Marks** **Part C - Essay Type Questions – 10 Marks(Answer any 1 questions out of 2) 1x10 = 10 Marks** **<u>Practical Examination 35 Marks – Duration 2 Hours</u>** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1. Introduction to Computers , Peter Norton's Second Edition Publisher. McGraw-Hill
2. Computer Fundamentals , Pradeep K Sinha and Priti Sinha , BPB Publications

SEMESTER – II

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**PROGRAMMING USING PYTHON**					
Type of Course	**DSC A**					
Course Code	**MG2DSCADS100**					
Course Level	**100 -199**					
Course Summary	This course introduces programming concepts and problem-solving using Python, focusing on data types, control structures, functions, and data structures, with hands-on exercises to develop coding and debugging skills for efficient program development					
Semester	**II**	**Credits**			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand problem statements, appropriate programming concepts, approaches, algorithms, and language translators to develop executable solutions.	U	1,2
2	Understand the fundamental Python concepts including variables, operators, control flow, strings, and input/output statements for basic programming.	U	1,2,3
3	Analyse different Python data structures and functions to design efficient solutions for computational problems.	An	1,2,3
4	Apply Python programming constructs such as operators, control statements, strings,data structures and functions to develop and analyse solutions for basic computational problems.	A	1,2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Programming Concepts** -Approaches in programming-Structured Programming, modular Programming, object oriented Programming concepts -**Problem Solving and Program Development** - steps in problem solving using computers, algorithm, flow chart	7	1
	1.2	**Programming languages** - machine language, Assembly language, High-level language - language translators - compiler, Interpreter, Assembler	5	1
	1.3	**Program Execution** - From source code to executable - Role of compiler, interpreter, and linker	3	1
2	2.1	**Introduction to Python** - Features of python - Variables, Constants, and Data Types - Type conversion - Operators and Precedence	5	2
	2.2	**Control Flow Statements** - Conditional Flow statements-if, if else, if elif else - Loop Control Statements – for, while, continue, break and pass statements	7	2
	2.3	**Strings** - indexing - slicing - Built-in- functions. Input and Output Statements.	3	2
3	3.1	**Lists** - Creating Lists - Basic List Operations - list() function - Built-in-functions.	3	3
	3.2	**Tuples -** Creating Tuples - Basic Tuple Operations - Tuple() function - Built-in-functions.	3	3
	3.3	**Dictionaries -** Creating Dictionary - Accessing and modifying - dict() function - Built-in-functions.	3	3
	3.4	**Sets** - Creating sets - Set methods.	2	3
	3.5	**Functions -** Built-in-Functions- user defined functions - Function Definition and call - formal and actual arguments - Command Line Arguments	4	3
4	4.1	1. Demonstrate variables, constants, and type conversion. 2. Calculate the area of a circle using operators. 3. Input two numbers and display results of arithmetic, relational, and logical operations. 4. Check whether a number is positive, negative, or zero. 5. Find the largest of three numbers using if-else. 6. Print the first 10 natural numbers using a loop. 7. Find the sum of numbers from 1 to *n* using a while loop.	9	4
	4.2	8. Access string characters using indexing and slicing. 9. Count vowels and consonants in a string. 10. Check whether a string is palindrome.	12	4

		11. Demonstrate built-in string functions: `upper()`, `lower()`, `replace()`, `split()`. 12. Create a list and perform insert, append, and remove operations. 13. Create a tuple and display elements using indexing. 14. Use tuple functions: `len()`, `max()`, `min()`. 15. Create a dictionary of student names and marks, and print it. 16. Modify and delete dictionary elements, and display keys and values.		
	4.3	17. Write a function to find the factorial of a number. 18. Write a function to calculate the nth Fibonacci number (recursive). 19. Write a function to calculate the sum of digits of a number. 20. Write a function with default arguments (e.g., greeting message).	9	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **<u>Written Test - 50 Marks - Duration 1 Hour 30 Minutes</u>** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **<u>Practical Examination 35 Marks – Duration 2 Hours</u>** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1. R. Nageswara Rao, *Core Python Programming*, Dream tech Press.
2. Gowrishankar S, Veena A., "Introduction to Python Programming.", CRC Press, Taylor & Francis Group, 2019
3. E. Balagurusamy, Programming in ANSI C, McGraw Hill

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Office Automation**					
Type of Course	**MDC**					
Course Code	**MG2MDCADS100**					
Course Level	**100-199**					
Course Summary	This course introduces computer office applications, enabling students to create and manage documents, spreadsheets, and presentations effectively.					
Semester	**II**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2		1		60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	**Understand the features of word processing** to create, edit, and format professional documents with tables and graphics.	U	1,2
2	Demonstrate proficiency in **spreadsheet applications** by managing data, using formulas/functions, and creating charts.	An	1,2
3	Design and deliver effective **presentations** using multimedia elements, slide layouts, transitions, and animations.	An	1,2,3
4	Students will be able to create, format, and manage documents, spreadsheets, presentations, and forms using tools like Google Docs, Google Sheets, Google Slides, and Google Forms to effectively handle data, design content, and perform basic analysis.	A	1,2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Word processing - Introduction - Basic Menus -Insert, Delete, Cut, Copy, Paste, Undo, Redo, Find, Search, Replace	3	1
	1.2	Formatting page - Page Orientation - Viewing Documents - Setting Tabs - Page Margins – Indents – Ruler	3	1
	1.3	Formatting Techniques - Font Formatting - Paragraph Formatting - Page Setup - Headers & Footers - Bullets and Numbered List - Borders and Shading	2	1
	1.5	Creating Tables- Table settings, Borders, Alignments, Insertion, deletion, Merging, Splitting, Sorting, and Formula, Drawing - Inserting Clip Arts, Pictures	3	1
2	2.1	Spreadsheet- Layout of a worksheet- Title bar, Menu bar, Formula bar. Cell addressing, Data entry, Data Types, Data formatting, Data selection, Named ranges, Importing Data	6	2
	2.2	Formulas- Absolute addressing and relative addressing, IF statement, Functions- Categories, Exploring functions -Mathematical, Statistical, Text, Financial, and Date function	4	2
	2.3	Data representations and comparison using charts and pivot table- Different type of charts, Creation of charts, Setting Chart parameters, Customising charts, Creating and Manipulating Pivot table.	2	2
3	3.1	Creating Presentation - Advantages of Presentation -Slides - Inserting and Deleting Slides	3	3
	3.2	Formatting Slides - Slide Layout Views in Presentation - Inserting new slides with different layout	2	3
	3.3	Editing a slide - Inserting picture to a slide - Inserting Sounds and Videos - Colour Scheme - Background Action Buttons - Slide Transition - Custom Animation.	2	3
4	4.1	**Google Docs (Word Processing)** 1. Create a document and perform editing operations (cut, copy, paste, find & replace). 2. Format text using different fonts, sizes, colors, and styles (bold, italic, underline). 3. Set page layout (margins, orientation) and apply paragraph formatting (alignment, spacing). 4. Insert headers, footers, and page numbers. 5. Create bulleted and numbered lists with multiple levels. 6. Insert a table, format it, and enter sample data. 7. Insert images and shapes, and apply text wrapping.	10	4

	4.2	**Google Sheets (Spreadsheets)** 1. Enter and format different data types (text, numbers, date). 2. Demonstrate relative and absolute cell addressing using formulas. 3. Perform arithmetic calculations using formulas. 4. Use functions such as SUM, AVERAGE, MIN, MAX, COUNT. 5. Apply conditional formatting to highlight data. 6. Create charts (bar, pie, line) and customize them. 7. Create a marks sheet and calculate total, average, and grade using IF function.	10	4
	4.3	**Google Slides (Presentations)** 1. Create a presentation with at least 5 slides using different layouts. 2. Insert and delete slides, and apply themes/backgrounds. 3. Add images, videos, and shapes to slides. 4. Apply slide transitions and object animations. 5. Insert action buttons or hyperlinks for navigation between slides. **Google Forms (Data Collection)** 1. Create a Google Form with different question types (MCQ, short answer, checkbox), collect responses, and link it to Google Sheets for analysis.	10	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 15 Marks** **Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**

	B. End Semester Evaluation **Written Test - 35 Marks - Duration 1 Hour** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 15 Marks(Answer any 3 questions out of 4) 3x5 =15 Marks** **Part C - Essay Type Questions –10 Marks(Answer any 1 question out of 2) 1x10 = 10 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

References

1. "Learning Computer Fundamentals, MS Office and Internet & WebTechnology", Dinesh Maidasani, Firewall Media - , Lakshmi Publications.

2. "Microsoft Office 2010: Advanced", Gary B. Shelly, Misty E. Vermaat - CENGAGE Learning 2010

3. Documentation Team, LibreOffice. LibreOffice 7.1 Calc Guide. N.p., Jean Hollis Weber, 2021.

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SEMESTER - III

Mahatma Gandhi University
Kottayam

Programme	**BSc (Honours) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Data Structures and Algorithms Using C++**					
Type of Course	**DSC**					
Course Code	**MG3DSCADS200**					
Course Level	**200-299**					
Course Summary	This course offers a comprehensive course focused on understanding, analyzing, and implementing fundamental data structures and algorithms—covering concepts like asymptotic analysis, recursion, arrays, stacks, queues, linked lists, trees, and basic searching and sorting techniques—using C++.					
Semester	**III**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3		1		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the concepts of algorithms, asymptotic analysis, recursion, fundamental data structures and their representations, and the working principles of basic searching and sorting algorithms.	U	1
2	Analyze stack and queue data structures, their array representations, operations, and applications such as expression evaluation and infix to postfix conversion.	An	1,2
3	Analyze linked lists and tree data structures, including their memory representation, operations, basic terminologies, and traversal techniques in binary trees and binary search trees.	An	1,2
4	Apply and demonstrate fundamental data structures and algorithms using C++, including arrays, searching, sorting, stacks, queues, and linked lists with their operations.	A	3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Algorithms: Definition, Asymptotic Analysis of Algorithms- The "Big-Oh" Notation, Big Omega Notation, Recursion	4	1
	1.2	Data Structures: Definition, Classification- Linear Data Structures, Non-Linear Data Structures, Abstract Data Type(ADT)	2	1
	1.3	Introduction, Linear Arrays, Representation of Linear Arrays in Memory, Multidimensional Arrays.	4	1
	1.4	Searching Algorithms: Linear Search, Binary Search.	3	1
	1.5	Sorting Algorithms: Bubble Sort, Insertion Sort.	3	1
2	2.1	Stack: Introduction, Array Representation and Basic Operations :- Push, Pop.	5	2
	2.2	Application of Stacks, Evaluating Arithmetic Expression using Stacks, Infix to Postfix Notation.	5	2
	2.3	Queues: Introduction to Queue - Array Representation of Queues - Operations on a Queue- Insertion, Deletion	5	2
3	3.1	Linked Lists: Singly Linked List - Representation in Memory	4	3
	3.2	Operations on a Singly Linked List – Insertion, Deletion, Searching and Traversal.	5	3
	3.3	Trees: Definition - Basic Terminologies - Node, Parent, Child, Link, Root, Leaf, Level, Height of a tree and node, Depth of a tree and node, Degree of a tree and node, sibling, Ancestors, Path, Path Length.	5	3
4	4.1	**(Programmes using C++)** Program to create and traverse a one-dimensional array. Program to insert an element into an array at a given position. Program to delete an element from an array. Program to perform matrix addition using 2D arrays. Program to find the transpose of a matrix. Program to implement Linear Search. Program to implement Binary Search (use sorted array). Program to implement Bubble Sort. Program to implement Insertion Sort.	10	4
	4.2	Program to implement a stack using an array. Program to perform Push and Pop operations on a stack. Program to implement a queue using an array. Program to perform Insertion and Deletion operations.	10	4
	4.3	Program to create a singly linked list. Program to perform insertion in a singly linked list (beginning, middle, end). Program to perform deletion in a singly linked list.	10	4

5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA For Theory - 25 Marks** Written Test / Seminar / Viva/ Assignments **CCA For Practical - 15 Marks** Practical assignments / Lab Record/Observation of practical skills / Viva
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES :

1. Fundamentals of Data Structures in C++, E.Horowitz- S.Sahni, Galgotia-2006
2. Data Structures and Algorithm Analysis in C++, M.A.Weiss, Pearson Education Fourth Edition
3. Data Structures, Algorithms and Applications in C++, Sartaj Sahni, University Press

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Introduction to Artificial Intelligence and Data science**					
Type of Course	**DSC A**					
Course Code	**MG3DSCADS201**					
Course Level	**200 -299**					
Course Summary	This course introduces the fundamentals of Artificial Intelligence and Intelligent Agents, explores problem-solving and knowledge-based agents, provides an overview of Data Science and its lifecycle, emphasizes exploratory data analysis (EDA) techniques, and covers essential tools and data visualization methods using Python and its libraries.					
Semester	**III**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Programming skills and understanding of data privacy concepts.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the fundamentals of Artificial Intelligence, intelligent agents, and knowledge-based agents.	U	1
2	Explain the evolution, need, and roles of Data Science along with its life cycle and applications.	U	1,2
3	Apply exploratory data analysis (EDA) techniques using Python and its libraries like Numpy, Pandas, and Matplotlib.	A	2
4	Analyze and interpret data visualizations including bar plots, histograms, box plots, and scatter plots for effective data presentation.	An	3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Al What is AI ? Intelligent Agents: Agents and environment, the concept of Rationality, the nature of environment, the structure of Agents .	5	1
	1.2	Knowledge-Based Agents: Introduction to Knowledge-Based Agents, The Wumpus World as an Example World	4	1
	1.3	Problem-solving: Problem-solving agents	3	1
2	2.1	Introduction to Data Science - Need of data Science - Evolution of Data Science – Data Science Roles	5	2
	2.2	Data Science Life Cycle - Applications of Data Science in various fields	4	2
	2.3	Prerequisites & Tools for Data Science - Data Security Issues.	5	2
3	3.1	Exploratory Data Analytics – Importance of EDA – Types of EDA	4	3
	3.2	Univariate Analysis, Bivariate Analysis, Multivariate Analysis	5	3
	3.3	Specialized EDA Techniques - Steps for performing EDA -	5	3
	3.4	Tools for Performing EDA.	5	3
4	4.1	Tools: Python, Numpy, working with Numpy arrays, Scipy, Matplotib, Seaborn, Pandas.	15	4
	4.2	Data Visualization using bar plot, line plot, histogram, pie chart, box plots, density plots, and scatter plot.	15	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA For Theory - 25 Marks** Written Test / Seminar / Viva/ Assignments **CCA For Practical - 15 Marks** Practical assignments / Lab Record/Observation of practical skills / Viva
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes**

	Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES:

1. Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd edition, Prentice Hall
2. Dan W Patterson, Introduction to Artificial Intelligence & Expert Systems, PHI Learning 2010.
3. Lavika Goel, Artificial Intelligence: Concepts and Applications, Wiley, 2021
4. Jojo Moolayil, "Smarter Decisions : The Intersection of IoT and Data Science", PACKT, 2016.
5. Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015.
6. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013
7.Wes Mckinney, "Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter" 3rd Edition, O'Reilly, 2022. Free online access: https://wesmckinney.com/book/
8.Fabio Nelli, "Python Data Analytics Data Analysis and Science Using Pandas, Matplotlib, and the Python Programming Language", Edition 1, 2015, Apress.

SUGGESTED READINGS

1. Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Global
2. Tilman M. Davies " The Book of R" 2016, No Starch Press
3. T. M. Mitchell, "Machine Learning", McGraw Hill, 2017

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Computer Security (System Security Specialization)**					
Type of Course	**DSE**					
Course Code	**MG3DSEADS200**					
Course Level	**200-299**					
Course Summary	This course introduces the fundamentals of computer, operating system, and network security, focusing on threats, vulnerabilities, attacks, and countermeasures to protect digital assets.					
Semester	**III**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites , if any	Basic knowledge of computer systems, operating systems, computer networks, and programming fundamentals.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the core concepts of computer security and its significance in modern computing systems.	U	1
2	Analyze various types of threats, vulnerabilities, and cyber-attacks affecting systems and networks.	An	2
3	Apply access control, authentication mechanisms, and malware defence strategies.	A	3
4	Evaluate operating system and network security models to recommend suitable improvements.	E	4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	What Is Computer Security- Values of Assets, The Vulnerability–Threat–Control Paradigm.	5	1
	1.2	Threats- Confidentiality, Integrity, Availability, Types of Threats, Types of Attackers. Harm- Risk Common Sense,	5	1
	1.3	Method–Opportunity–Motive-Vulnerabilities, Controls. Authentication-Identification Versus Authentication,	5	1
	1.4	Access Control- Access Policies, Implementing Access Control, Procedure-Oriented Access Control, Role-Based Access Control.	5	1
2	2.1	Malicious Code, Malware—Viruses, Trojan Horses, and Worms,	5	2
	2.2	Technical Details: Malicious Code. Countermeasures for Users . Browser Attacks- Browser Attack Types. Web Attacks Targeting Users- False or Misleading Content, Malicious Web Content.	5	2
	2.3	Email Attacks-Fake Email, Fake Email Messages as Spam, Fake (Inaccurate) Email Header Data, Phishing, Protecting Against Email Attacks.	6	2
3	3.1	Security in Operating Systems- Operating System Structure, Security Features of Ordinary Operating Systems, Protected Objects.	6	3
	3.2	Security in the Design of Operating Systems-Simplicity of Design, Layered Design, Kernelized Design, Reference Monitor.	6	3
4	4.1	Network Concepts- Network Transmission Media, Protocol Layers. Addressing and Routing.	5	4
	4.2	Threats to Network Communications, Interception, Modification, Fabrication, Interruption,	4	4
	4.3	Port Scanning.	3	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA For Theory - 30 Marks** Written Test / Seminar / Viva/ Assignments

	B. Semester End examination **ESE for Theory : 70 Marks (2 Hours)** **<u>Written Test (70 Marks)</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Security in Computing, Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, , fifth edition , 2015 Pearson Education.

William Stallings, Operating Systems: Internals and Design Principles, 7th Ed., Prentice Hall, 2011

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Basics of Robotics (Robotics Specialization)**					
Type of Course	**DSE**					
Course Code	**MG3DSEADS201**					
Course Level	**200-299**					
Course Summary	To provide an in-depth understanding of the fundamental concepts of robotics, covering its historical evolution, core disciplines like control theory and artificial intelligence, key components such as sensors, actuators, and control systems, as well as various types of robots, their applications, and principles of feedback control					
Semester	**III**	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0		**60**
Pre-requisites , if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Explain the fundamental concepts of robotics including its definition, historical development, and core disciplines such as control theory, cybernetics, and artificial intelligence. Identify and describe the major components of a robot including embodiment, sensing, action mechanisms, control systems (brains and brawn), and levels of autonomy.	U	1, 2
2	Classify various types of robots based on application, locomotion, design, autonomy, and intelligence level; and describe their key characteristics and use cases.	An	2, 3
3	Explain the differences between active and passive actuation; identify various types of actuators and sensors used in robotics; and describe sensor technologies based on physical properties, sensing mechanisms, and processing levels.	U	1, 2
4	Explain the principles of feedback control systems in robotics; differentiate between open-loop and closed-loop control; and describe the roles and effects of proportional, integral, derivative, and combined (PID) control strategies.	An	2, 3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Robotics-Definition, History of Robotics-Control Theory, Cybernetics , Artificial Intelligence (Concept only)	8	1
	1.2	Robot Components-Embodiment, Sensing, Action, Brains and Brawn, Autonomy	7	1
2	2.1	Types of Robots **By Application** (Industrial Robots, Medical Robots, Service Robots, Military Robots ,Space Robots, Domestic Robots, Exploration Robots, Educational Robots-)	8	2
	2.2	**By Locomotion** (Wheeled, Legged, Flying, Swimming Robots, Stationary Robots) **By Form or Design(**Humanoid, Animal-like Robots, Swarm, Modular, Soft Robots) **By Autonomy**(Autonomous, Semi-Autonomous, Remote-Controlled) **By Intelligence Level**(Pre-programmed Robots, AI-powered Robots, Collaborative Robots)	7	2
3	3.1	Active vs. Passive Actuation ,Types of Actuators	8	3
	3.2	Sensors-Proprioceptive sensors, Exteroceptive sensors, Physical Property → Sensing Technology, Levels of Processing Simple Sensors-Passive vs. Active Sensors, Switches, Light Sensors Complex Sensors-Ultrasonic or Sonar Sensing, Laser Sensing ,Visual Sensing,	7	3
4	4.1	Stay in Control Feedback Control-Feedback or Closed Loop Control ,The Many Faces of Error.	7	4
	4.2	Types of Feedback Control-Proportional Control, Derivative Control, Integral Control, PD and PID Control, Feed forward or Open Loop Control.	8	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA for Theory – 30 Marks** **Written Test / Seminar / Viva/ Assignments**

	B. End Semester Evaluation **ESE for Theory : 70 Marks (2 Hours)** **<u>Written Test (70 Marks)</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES :

1. The Robotics Primer ,Maja J Matari. Illustrations by Nathan Koenig the MIT Press Cambridge, Massachusetts London, England
2. Robotics and control R.K. Mittal, I J Nagrath, McGraw Hill Education

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Introduction to IoT and its Applications (Internet of Things Specialization)**					
Type of Course	**DSE**					
Course Code	**MG3DSEADS202**					
Course Level	**200-299**					
Course Summary	To provide a comprehensive introduction to Internet of Things (IoT) and Machine-to-Machine (M2M) systems and Applications.					
Semester	**III**	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Describe the vision, architecture, and fundamental components of the Internet of Things (IoT), including smart and hyperconnected devices and server-end technologies.	U	1, 2
2	Identify and apply development tools, platforms, and integration techniques for implementing IoT solutions, including device interfacing, sensor networks, and RFID technologies.	U	1, 2
3	Differentiate between IoT and M2M technologies, describe M2M architecture and communication, and illustrate real-world IoT applications such as smart homes, wearable devices, and smart cities	An	2, 3
4	Explain the architectural design principles, communication technologies, and standard models for connected IoT/M2M systems, including data management and device integration at the gateway level.	An	1, 2, 3

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Internet of Things- Definition & IoT Vision, Smart and Hyper connected Devices,	5	1
	1.2	IoT Conceptual framework, IoT Architectural view, Technology behind IoT- Server-end Technology, Major Components of IoT System	10	1
2	2.1	Development Tools and Open-source Framework for IoT Implementation, APIs and Device Interfacing Components , Platforms and Integration Tools	8	2
	2.2	Sources of IoT-Popular IoT Development Boards, Role of RFID and IoT Applications, Wireless Sensor Networks (WSNs),	7	2
3	3.1	Differentiating Internet of Things from M2M ,M2M Communication-M2M to IoT,M2M Architecture, Software and Development Tools,	10	3
	3.2	Examples of IoT-Wearable Smart Watch, Smart Home, Smart Cities.	5	3
4	4.1	Design Principles for Connected Devices-Introduction, IoT/M2M Systems, Layers and designs standardisation, Modified OSI Model for the IoT/M2M Systems, ITU-T Reference Model, ETSI M2M Domains and High-level Capabilities	8	4
	4.2	Communication technologies-Wireless Communication Technology, Wired Communication Technology, Communication Technologies - A Comparison, Data enrichment , Data consolidation and Device management at gateway, Ease of designing and affordability	7	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment** **CCA for Theory - 30 Marks** **Written Test / Seminar / Viva/ Assignments**

	B. End Semester Evaluation **ESE for Theory : 70 Marks (2 Hours)** **<u>Written Test (70 Marks)</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES :

1.INTERNET OF THINGS Architecture and Design by Principles Raj Kamal McGraw Hill Education (India) Private Limited
2.Internet of Things for Dummies by Wiley Brand John Hicklin Bill Shurvinton Gemma .Beard Compliments of CGI
3.An Introduction to IoT: Getting Started with the Internet of Things Written by Andrew Collett
4. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Digital Interface Design**					
Type of Course	**DSC B**					
Course Code	**MG3DSCADS202**					
Course Level	**200 – 299**					
Course Summary	This course enables learners to design and develop simple, visually appealing web pages by understanding and applying essential **HTML and CSS concepts**, including text formatting, lists, links, images, forms, multimedia, and basic animations, while incorporating fundamental web design principles.					
Semester	**III**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand how to create web pages using essential HTML elements, text formatting, lists, links, images, forms, and basic animations.	U	1
2	Understand how to create interactive forms with various input types and attributes, and embed multimedia elements like audio and video into web pages.	U	1
3	Able to style web pages effectively using CSS for enhanced visual presentation.	A	2
4	Create simple web pages and user interfaces by combining HTML and CSS, incorporating forms and controls, and applying fundamental web design principles.	A	3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
	1.1	Introduction to HTML, Essential HTML Elements- Headings, paragraphs, line breaks	3	1
	1.2	Text formatting tags (bold, italic, underline, etc.) , HTML Color Lists: Ordered, unordered, definition lists, Links and anchor tags, Marquee, Images and image attributes	4	1
	1.3	Tables and table formatting, Padding and Spacing, Colspan and Rowspan, Table Styling	4	1
2	2.1	Div and Span elements, Forms and form elements:	5	2
	2.2	HTML Input Types, Input Attributes, Input Form Attributes.	4	2
	2.3	Multimedia in HTML-Embedding audio and video, <iframe> usage	5	2
3	3.1	Introduction to CSS, CSS syntax (selectors, properties, values), Types of CSS	5	3
	3.2	Selectors and Properties-Basic selectors: element, class, ID. Grouping and combining selectors, CSS color, units, and fonts	5	3
	3.3	Text and Font Styling, Font properties (family, size, weight), Text alignment, spacing, decoration	5	3
	3.4	Backgrounds and Borders-Background color, image, repeat, position	5	3
4	4.1	Simple HTML and CSS programs	10	4
	4.2	HTML programs Using Form and controls	10	4
	4.3	Web design using HTML	10	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA for Theory: 25 Marks** **Written Test / Seminar / Viva/ Assignments** **CCA for Practical: 15 Marks**

	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES :

1. "HTML, DHTML, JavaScript, Pearl &CGI ", Ivan Bayross - Fourth Revised Edition, BPB Publication
2. "Mastering HTML, CSS & Javascript Web Publishing", Laura Lemay, Rafe Colburn , Jennifer Kyrnin,2016.
3. "HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)", DT Editorial Services (Author), Paperback 2016, 2nd Edition.
4. "World Wide Web Design with HTML", C. Xavier,TMH Publishers 2001.
5. Head First HTML and CSS -Elizabeth Robson and Eric Freeman,2nd Edition, Kindle Edition
6. HTML and CSS: Design and Build Websites author-Jon Duckett,1st edition, Wiley Publication

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Environmental Sustainability and Human Rights**					
Type of Course	**VAC**					
Course Code	**MG3VACADS200**					
Course Level	**200-299**					
Course Summary	This course offers basics of promoting human rights and ensuring sustainable development					
Semester	**III**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites , if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Demonstrate awareness of natural resources and eco system functions	U	1
2	Recall the basic concepts of ecosystems, biodiversity, conservation, and global environmental issues.	K	1
3	Critically analyse environmental challenges, ethics, legislations for sustainable development	An	2
4	Appreciate biodiversity, protection and promotion of human rights	A	3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content For Classroom Transaction (Units)

Module	Units	Course description	Hrs	CO No.
	1.1	Ecological studies- introduction, definition, scope and importance	3	1

1	1.2	Natural resources, renewable and non-renewable, associated problems, forest resource, water resource, mineral resource, food resource, energy resource and land resource	7	1
2	2.1	Eco system- concept, structure and functions of eco system	3	2
	2.2	Bio diversity, hot spots, threats to biodiversity, habitat loss, poaching of wildlife, man wildlife, conservation of bio diversity	4	2
	2.3	Global concerns- climate change, global warming, ozone layer depletion, acid rain, nuclear accidents, disaster management	5	2
3	3.1	Environmental pollution (air ,water, soil, noise ,marine and thermal) cause effects and control	3	3
	3.2	Sustainable development - meaning, concept, need and goals	2	3
	3.3	Environmental legislations - Environment protection act, water act, Air act, wildlife protection act, Forest conservation act	4	3
4	4.1	Human rights - Introduction, historical development and concept of rights, generation of human Rights, international human right document	6	4
	4.2	Human rights under the Indian constitution, fundamental rights, directive principles, right of (women, children, minorities and prisoners) Role of science and technology in protecting human rights, Human right awareness in education	8	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA for Theory - 25 Marks** **Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES :

1) Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education, Erach Bharucha, for University Grants Commission.
2) Green Home Computing for dummies, Woody Leonhard and Katherine Murray, Wiley Publishing, 2009.
3) Environmental Biology, Agarwal, K.C. Nidi Publ. Ltd. Bikaner. 2001

SUGGESTED READINGS:

1 Environmental Encyclopedia, Jaico Publ. House, Mumabai,
2 Environmental Science systems & Solutions, Mckinney, M.L. & School, R.M.. Web enhanced edition.
3 Environmental Protection and Laws. Jadhav, H &Bhosale, V.M. Himalaya Pub. House, Delhi

SEMESTER – IV

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**OPERATING SYSTEMS**					
Type of Course	**DSC A**					
Course Code	**MG4DSCADS200**					
Course Level	**200-299**					
Course Summary	This course provides a comprehensive understanding of operating systems (OS), focusing on their design, functionality, and core components. Students will explore fundamental concepts, including process management, scheduling, synchronization, memory management, and strategies to handle deadlocks and virtual memory. Also there is an introduction given to artificial intelligence based operating sytems					
Semester	**IV**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0		60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Describe the structure, types, and services of operating system.	U	1
2	Describe process ,process scheduling ,CPU Scheduling algorithms and Multithreading	An	2
3	Describe the techniques for detecting, preventing deadlocks and deadlock management techniques.	An	2
4	Describe the methods employed for memory management in computer systems. Understand the basics of AIOS	E	2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Operating Systems Overview: Definition. Functions, Structure- Simple, Layered, Microkernels	4	1
	1.2	Operating systems Operation-Dual-Mode operation and Timer. User Operating System Interface, System Calls, Types of system calls	4	1
2	2.1	Process: The Process, Process State , PCB , Threads , Process scheduling - Scheduling Queues , Schedulers , Context Switch	5	2
	2.2	Threads - Fundamentals, Multicore programming, Multithreading models, CPU Scheduling : Scheduling Criteria, Scheduling Algorithms	8	2
3	3.1	Process Synchronization: Introduction, Critical Section Problem, Mutual Exclusion, Semaphores, Monitors.	8	3
	3.2	Deadlocks: System model, deadlock characterization, deadlock prevention, avoidance, Banker's algorithm, Deadlock detection, and recovery from deadlocks.	10	3
4	4.1	Memory Management: Logical and Physical address map, Swapping, Contiguous Memory allocation Internal and External fragmentation and Compaction, Paging, Segmentation	8	4
	4.2	Virtual Memory: Demand paging, Page Replacement algorithms- FIFO,LRU, Optimal. Allocation of frames, thrashing.	8	4
	4.3	AIOS Introduction , AIOS Implementation,AIOS Architecture, Features , Current Progress , Benefits Of AIOS ,Future Scope	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks** **Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **ESE for Theory : 70 Marks (2 Hours)** **Written Test (70 Marks)** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks**

	Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

References

1.Abraham Silberschatz, Peter Baer Galvin, Greg Gagne (2012), Operating System Principles, 9th edition. Wiley India Private Limited, New Delhi.
2.Ashuthosh Kumar,Ankit Kumar Singh , Ashima Mehta International Journal Of Advanced Research ,Communication And Technology (IJARSCT)VOL 4 ISSUE 4, APRIL 2024 www.ijarsct.co.in

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Database Management Systems and Security**					
Type of Course	**DSC A**					
Course Code	**MG4DSCADS201**					
Course Level	**200-299**					
Course Summary	This course provides a comprehensive exploration of fundamental concepts in database management. The course delves into the Relational Model, Entity-Relationship Modelling, SQL, normalization. The course also covers transaction processing, desirable properties of transactions					
Semester	**IV**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	**Understand** the fundamental concepts of databases, including DBMS architecture, data models, schema, data independence, and database system environment.	U	1
2	**Analyse** data modeling techniques such as ER modeling, relational model concepts, normalization, and transaction processing.	An	2
3	**Apply** SQL queries, database security methods, and recovery techniques for effective database management.	A	3
4	**Create** database tables and perform operations using DDL and DML commands to solve practical problems.	C	3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Databases: Data - Database - DBMS, Characteristics of Database System, Applications of Database, Database users – Database Administrator, database designer , end users.	2	1
	1.2	Data Models, Database Schema - Instance - Database state, Three Schema Architecture and Data Independence	2	1
	1.3	Categories of Data Model , Database system environment, Overall Architecture	2	1
2	2.1	Entity, Entity types, Entity Sets, Attributes, types of attributes and Keys- Primary key, super key, candidate key.	3	2
	2.2	Relationship, Relationship Types, Relationship sets, Roles and Structural Constraints, Weak Entity Types, Entity Relational model - Notation of ER diagram .Sample ER Diagrams	5	2
	2.3	Relational Data Model Concepts: Domain, Attributes, Tuples and Relations. Characteristics of Relations.	3	2
	2.4	Normalization: – Functional Dependencies ,Normal Forms -1NF - 2NF - 3NF - BCNF	4	2
	2.5	Transaction Processing: Introduction to Transaction Processing, Transaction state , Desirable Properties of Transactions	4	2
3	3.1	SQL: Data Definition and Data Types, Specifying Constraints, Basic Retrieval Queries, Insert, Delete and Update Statements. Data Definition commands: CREATE, ALTER, DROP - Adding constraints in SQL	3	3
	3.2	Basic SQL Queries: INSERT, SELECT, DELETE, UPDATE, Substring comparison using LIKE operator, BETWEEN operator	2	3
	3.3	Ordering of rows – SQL set operations: UNION, EXCEPT, INTERSECT, AGGREGATE FUNCTIONS.	3	3
	3.4	Database Security –Databases Security Problems. Introduction to database security concepts, Methods for database security - Discretionary access control method, Mandatory access control	6	3
	3.5	Crash Recovery, Failure classification, Recovery concepts, Log base recovery techniques, Checkpoints, Recovery with concurrent transactions.	6	3
4	4.1	Creating and altering the structure of a table in the database using DDL commands	2	4
	4.2	Working with DML command : - Inserting rows to the table using INSERT command	3	4

		Modifying data in the table using UPDATE and DELETE Basic querying using SELECT		
	4.3	I.Create a table named STUDENT with columns : Rollno.Sname,dept,city,cgpa etc Generate and execute the following queries : 1. 1.Add a new column phone_number of type VARCHAR(15) to the STUDENT table. 2. Update the CGPA of student 'Arun' (enrollment_no: CS003) to 7.0. 3. Delete all students from the STUDENT table who have a CGPA less than 7.5. 4. Find the average CGPA of all students in the Computer Science department. 5. Display the number of students in each department. II.Create a table named EMPLOYEE with columns : Emp_id , Emp_name, design, dept, salary, Date_Of_Join etc Generate and execute the following queries : 1. Increase the size of department column to 35. 2. Update the salary of all employees in the IT department by increasing it by 10% 3. Delete all employees from the EMPLOYEE table who have a salary less than 40000 4. Find the maximum salary among all employees in the Sales department 5. Display the average salary of employees in each department. III. Create a table named PATIENT with columns : patient_id, patient_name,age, gender,disease , Docter_name etc. Generate and execute the following queries : 1. Add a new column admission_date of date data type. 2. Update the doctor name for patient 'Dr.Hari' to 'Dr. Venu'. 3. Display the details of patients above 50 years. 4. Find the average age of patients in the table. 5. Display the number of male and female patients.	25	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA for Theory : 25 Marks** Written Test / Seminar / Viva/ Assignments **CCA for Practical : 15 Marks**

	B. End Semester Evaluation **<u>Written Test - 50 Marks - Duration 1 Hour 30 Minutes</u>** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **<u>Practical Examination 35 Marks – Duration 2 Hours</u>** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1. Fundamentals of Database Systems, Elmasri, Navathe,Pearson,6th Ed.
2. Database system concepts ,Silberschatz, Korth, and Sudarshan, McGrawHill, 6th Ed.
3. SQL/ PL/SQL,Bayross, Ivan BPB,New Delhi
4. Database Security and Auditing , Hassan A. Afyouni, India Edition 2009
5. Database Security , SilvanaCastano , Second Edition 1994 , Pearson Education.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Biometric Security (System Security Specialization)**					
Type of Course	**DSE**					
Course Code	**MG4DSEADS200**					
Course Level	**200-299**					
Course Summary	To provide an understanding of biometric technologies, their standards, strengths and weaknesses, and equips students with the skills to design secure and effective biometric authentication systems.					
Semester	**IV**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Recognize biometric technologies and fundamentals, and the standards governing their implementation.	U	1
2	Remember various technologies in biometrics and the strengths and weaknesses of each biometric technology	K	1,2
3	Analyze various technologies in biometrics and the strengths and weaknesses of each biometric technology	An	1,2
4	Analyze concepts to design secure and effective biometric systems.	An	1,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Biometric Fundamentals- Benefits of Biometrics versus Traditional Authentication Methods, Benefits of Biometrics in Identification Systems	5	1

	1.2	Key Biometric Terms and Processes, Definitions-Verification and Identification, Logical Access, Physical Access, How Biometric Matching Works-Enrolment and Template Creation, Templates, Biometric Matching	5	1
	1.3	Accuracy in Biometric Systems-False Match Rate, False Non Match Rate, Failure-to-Enrol (FTE) Rate, Derived Metrics-Equal Error Rate ,Ability-to-Verify (ATV) Rate	5	1
2	2.1	Leading Biometric Technologies- Finger-Scan-Components, Working, Competing Finger-Scan Technologies-Optical Technology, Silicon Technology, Ultrasound Technology, Feature Extraction Methods: Minutiae versus Pattern Matching-Strength and Weakness of Finger scan	5	2
	2.2	Facial-Scan-Components, Working, Competing Facial-Scan Technologies- Eigen face, Feature Analysis, Neural Network, Automatic Face Processing, Strength and Weakness of Facial Scan	5	2
	2.3	Eye Based Biometrics- Iris-Scan-Components, Working, Strength and Weakness of Iris Scan-Retina-Scan,-Components, Working-Strength and Weakness of Retina Scan	5	2
3	3.1	Voice-Scan-Components-Working-Strength and Weakness of Voice scan, DNA Biometrics- Overall working, Strength and Weakness	5	3
	3.2	Signature-Scan-Components, Working, Strength and Weakness of Signature Scan	5	3
	3.3	Keystroke-Scan-Components, Working, Strength and Weakness of Keystroke scan	5	3
4	4.1	Multi biometrics and multi factor biometrics	5	4
	4.2	Two-factor authentication with passwords, tickets and tokens	5	4
	4.3	Executive decision, implementation plan.	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks** Written Test / Seminar / Viva/ Assignments
	B. End Semester Evaluation **Written Test - 70 Marks - Duration 2 Hours** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks**

	Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks

References

1. Biometrics -Identity verification in a network, Samir Nanavathi, Michel Thieme, and Raj Nanavathi, 1st Edition,2002.Wiley Eastern
2. “Handbook of Biometrics,Anil K Jain, Patrick Flynn and Arun A Ross,2010, Springer, USA

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Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Robot Operating System (Robotics Specialization)**					
Type of Course	**DSE**					
Course Code	**MG4DSEADS201**					
Course Level	**200- 299**					
Course Summary	To provide a comprehensive understanding of ROS architecture, communication mechanisms, launch and service management, and its application in advanced robotics using supporting tools.					
Semester	**IV**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the basics of ROS, its architecture, and workspace setup.	U	1,2,10
2	Develop and manage publisher–subscriber communication and logging in ROS.	A	1,2,4,9, 10
3	Implement launch files, services, and message recording in ROS.	An	1,2,4,9, 10
4	Apply ROS in advanced robotics applications and utilize supporting tools.	A	1,2,3,9, 10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.

1	1.1	Why ROS-Distributed computation, Software reuse, Rapid testing, Installing ROS,Configuring your account	5	1
	1.2	ROS package,ROS master,Nodes,Viewing the graph	5	1
	1.3	Messages and message types, Creating a workspace and a package, simple program-Compiling. Executing the program	5	1
2	2.1	Publisher program-Publishing messages,The publishing loop-subscriber program	5	2
	2.2	Log messages-Severity levels, Generating log messages, Viewing log messages, Enabling and disabling log messages	5	2
	2.3	Graph Resource names-Global names, Relative names, Private names, Anonymous names	5	2
3	3.1	Launch files-Creating launch files, Launching nodes inside a namespace, Remapping names	5	3
	3.2	Services-Terminology for services0-Finding and calling services from the command line-client program-Server Program	5	3
	3.3	Recording and replaying messages, Recording and replaying bag files, Bags in launch files	5	3
4	4.1	Applications-Cloud Robotics with ROS - Cloud Robotics, Orchestration of Robot Applications, Cross-Domain Container-Based Runtime, Robot-Aware Cloud Networking	5	4
	4.2	Video Stabilization of the NAO Robot Using IMU Data-Humanoid Robot NAO	5	4
	4.3	ROS Tools-roslaunch2,Penetration Testing ROS	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks** Written Test / Seminar / Viva/ Assignment
	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. O'Kane, Jason M. *A Gentle Introduction to ROS*. Version 2.1.6, University of South Carolina, 2018. ISBN 978-14-92143-23-9

2. Robotic Operating system (ROS) - The complete Reference (Volume 4), Studies in Computational Intelligence, Anis Koubaa

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**IoT Architecture and Protocols (Internet of Things Specialization)**					
Type of Course	**DSE**					
Course Code	**MG4DSEADS202**					
Course Level	**200-299**					
Course Summary	**This course covering IoT evolution, architectures, protocols, hardware platforms, data analytics, cloud integration, and real-world industrial applications.**					
Semester	**IV**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the foundational concepts, historical evolution, real-world applications, and key challenges of IoT, enabling them to analyse its impact on modern data-driven systems.	U	1,2
2	Design and analyse IP-based IoT architectures using protocols across the physical, network, and application layers, including CoAP and CoSIP functionalities.	An	1,2
3	Understand interoperable IoT systems using cloud platforms, Restful architectures, and efficient messaging protocols like MQTT and publish/subscribe communication models.	U	2,3
4	Understand the Implementation of secure and scalable IoT systems using lightweight cryptography, cloud/fog computing architectures, and IoT hardware platforms like Raspberry Pi and Arduino.	U	2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Definition of IoT and historical roots in wireless ad hoc and sensor networks	5	1
	1.2	Real-world IoT applications: smart cities, smart grids, industrial IoT, smart farming	3	1
	1.3	IOT Challenges and Impact	2	1
2	2.1	Designing the architecture of IP based IOT protocols: Physical Layer-IEEE802.15.4, & ZigBee, Bluetooth /BLE, low-power Wi-Fi, power line communications,	8	2
	2.2	Network layer- 6LoWPAN, Application layer- CoAP-Architecture, communication model, IOT Integration	6	2
	2.3	CoSip-Core Functionalities-Registration, session initiation ,presence and discovery, Messaging	8	2
3	3.1	Interoperability-Cloud IOT Platform architecture,	3	3
	3.2	REST Architecture web as a platform	5	3
	3.3	Messaging Queues and Publish/Subscribe communication-Advantage of pub/sub model, Disadvantage, Message Queue Telemetry Transport(MQTT)	3	3
4	4.1	Security Issues in IOT, Security Mechanisms-Traditional Vs Light weight Light weight Cryptography-Symmetric key LWC Algorithm, Public Key LWC algorithm	8	4
	4.2	Cloud and Fog computing for IOT- Big Stream oriented architecture, graph-based processing, Fog computing and IOT	5	4
	4.3	IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi-Introduction, components, ports, and Raspberry Pi 400.essential items for connecting Raspberry Pi, Assembling Arduino Board details.	4	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks / Seminar / Viva/ Assignments** **Written Test**

	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Internet of things architectures protocols and standards Simone Cirani/Gianluigi Ferrari/Marco Picone/Luca Veltri Wiley 2019
2.Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
3. Internet of Things Architecture design principles and Applications ,Raj Kamal, McGraw Hill
4.Getting started with Arduino Massimo Banzi O'Reilly publications
5..The official Raspberry Pi Beginners Guide Gareph Halfacree 4th edition

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Front End Development**					
Type of Course	**DSC B**					
Course Code	**MG4DSCADS202**					
Course Level	**200 – 299**					
Course Summary	This course provides a comprehensive understanding of JavaScript, covering core programming concepts, DOM manipulation, form validation, event handling, AJAX, and integration with HTML and CSS to build dynamic and interactive web applications.					
Semester	**IV**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand JavaScript programs using variables, data types, operators, control structures, functions, arrays, objects, and effectively integrate JavaScript with HTML for interactive web development.	U	1
2	Able to manipulate the DOM, handle user input and output, perform form validation, work with dates and strings,	A	3
3	Handle errors and debugging in JavaScript, manage forms and cookies, and develop dynamic web applications using AJAX for asynchronous client-server communication.	A	3
4	Implement simple JavaScript programs using control structures, manipulate the DOM, and handle events to create dynamic and responsive web interfaces.	A	3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to JavaScript, History and features, Variables and Data Types, Adding JavaScript to HTML (inline, internal, external)	5	1
	1.2	Operators and Expression, Control Structures, Loops, Loop Control	7	1
	1.3	Functions and Events ,Arrays and Objects	5	1
2	2.1	Basic Document Object Model traversing using JavaScript., Output System in JavaScript i.e. Alert, throughput, Input box, Console, Date and String handling in JavaScript.	8	2
	2.2	JavaScript: Form Validation like Required validator, length validator, Pattern validator. Advanced JavaScript, Combining HTML, CSS and JavaScript events and buttons, controlling your browser.	8	2
3	3.1	Error Handling, Debugging, Custom Errors, JavaScript and Forms, JavaScript Cookies	8	3
	3.2	Introduction to AJAX, Purpose, advantages and disadvantages, AJAX XMLHttpRequest Object, AJAX Request, AJAX Response AJAX based Web applications	4	3
4	4.1	Simple JavaScript Programs, Using Control Structures,	10	4
	4.2	Manipulate the DOM to dynamically change web content and structure.	10	4
	4.3	Handle events using JavaScript to create responsive user interfaces.	10	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA for Theory : 25 Marks** Written Test / Seminar / Viva/ Assignments **CCA for Practical : 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks**

	Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks **<u>Practical Examination 35 Marks – Duration 2 Hours</u>** **a.Demonstration** **b.Viva** **c.Record**

REFERENCES

1.Eloquent JavaScript (3rd Edition), Marijn Haverbeke
2.JavaScript: The Definitive Guide (7th Edition) , David Flanagan

ONLINE PLATFORMS

- https://developer.mozilla.org/en-US/docs/Web/JavaScript
- https://www.freecodecamp.org/learn/
- https://javascript.info

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Data Analysis Using Spreadsheet**					
Type of Course	**SEC**					
Course Code	**MG4SECADS200**					
Course Level	**200-299**					
Course Summary	This course covers the fundamentals of data and its types, the importance and applications of data analytics, practical skills in spreadsheet tools for data processing and visualization, data cleaning and transformation techniques, ethical considerations, and industry-specific real-world applications.					
Semester	**IV**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand different types of data (structured, unstructured, semi-structured) and the importance of data analytics.	U	1
2	Explain various types of data analytics and their real-world applications across industries like finance and marketing.	U	2
3	Apply spreadsheet tools and functions for data importing, preprocessing, and descriptive statistics.	A	3
4	Analyze data visualization techniques, create dashboards, and perform data cleaning and transformation effectively.	An	4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Understanding data and its types(structured, unstructured, semi-structured)- What is Data Analytics Types of data Analytics	5	1
	1.2	Importance of Data Analytics- Applications of Data Analytics	5	1
2	2.1	Introduction to Spreadsheet tool- Basic Functions, Data importing and pre-processing	6	2
	2.2	Descriptive Statistics Using Spreadsheet, Advanced Spreadsheet functions	6	2
	2.3	Data visualization techniques, Dashboard creation	5	2
3	3.1	Data Collection Methods - Different Data Sources & format - Data Cleaning and Transformation - Handling Missing Data and Outliers.	8	3
	3.2	Ethical considerations in data analytics	5	3
	3.3	Real-world Applications of Data Analytics- Industry specific applications (finance, marketing, operations)	5	3
4	4.1	Familiarisation of spread sheet.	15	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **a. Continuous Comprehensive Assessment (CCA) for Theory 15 Marks** Written Test / Seminar / Viva/ Assignments **CCA for Practical 15 Marks**
	B . End Semester Evaluation **<u>Written Test - 35 Marks - Duration 1 Hour</u>** **Part A - Short Answer Type Questions – 10 Marks (Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B – Short Essay Type Questions – 15 Marks(Answer any 3 questions out of 4) 3x5 = 15 Marks** **Part C - Essay Type Questions – 10 Marks(Answer any 1 questions out of 2) 1x10 = 10 Marks** **<u>Practical Examination - 35 Marks – Duration 2 Hours</u>** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1. “Data Analytics” by V.K. Jain, Khanna Book Publishing Company, 2024.
2. “Excel Data Analysis For Dummies" by Stephen L. Nelson and E. C. Nelson,John Wiley & Sons; 3rd edition, 2016
3. "Data Analysis Using Microsoft Excel" by Michael R. Middleton, Thomson, Brooks/Cole, 3rd edition, 2004

SUGGESTED READINGS

1. "Excel 2019 Bible" by Michael Alexander, Richard Kusleika, and John Walkenbach, John Wiley & Sons, 25 Sept 2018
2. "Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics" by Cliff T Ragsdale, Cegage learning Asia pet. 2015
3. “Mastering Excel” by WebTech Solutions, Khanna Publishing House, 2024.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Ethical Hacking**					
Type of Course	**VAC**					
Course Code	**MG4VACADS200**					
Course Level	**200 - 299**					
Course Summary	This course provides a comprehensive overview of ethical hacking principles, cyber threats, and attack types, along with practical skills in vulnerability assessment, system protection, network security protocols, firewall configurations, and hands-on experience using tools like VMware, John the Ripper, HYDRA, and Medusa.					
Semester	**1V**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the fundamentals of ethical hacking, including its steps, scope, authorization, and types of hackers.	U	1
2	Analyse various cyber-attacks such as malware, phishing, DoS/DDoS, SQL injection, and social engineering.	An	2
3	Apply network security concepts including firewalls, intrusion detection systems (NIDS, HIDS), and TCP/IP protocols.	A	3
4	Perform hands-on exercises using tools like VMware, Kali Linux, John the Ripper, HYDRA, and Medusa for penetration testing and password hacking.	A	4

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to EH, Steps, Define scope ,Authorization, Reconnaissance	3	1
	1.2	Gaining Access- Vulnerability analysis Maintaining access -Exploitation, Post-Exploitation, Clearing tracks, Documentation and reporting	4	1
	1.3	Hacking- Types of hackers	3	1
2	2.1	Various Attacks-Malware attacks, Phishing attacks	3	2
	2.2	Dos, DDos attacks	4	2
	2.3	Social engineering attacks Spoofing-IP Spoofing,	5	2
3	3.1	Protection of websites, Intrusion detection and prevention system-NIDS, HIDS	5	3
	3.2	Basic computer network protocols, TCP/IP Model	4	3
	3.3	Firewalls and its types	4	3
4	4.1	Password Hacking-John the Ripper, Dictionary attack using HYDRA, Medusa	5	4
	4.2	Wireless attacks: Wired equivalent privacy, WIFI protected access,WPA2	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **LECTURE**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment(CCA) 25 Marks** Written Test / Seminar / Viva/ Assignments
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Hacking for Beginners: Step By Step Guide to Cracking Codes Discipline, Penetration Testing, and Computer Virus. Learning Basic Security Tools on How To Ethical Hack and Grow Paperback Import, 29 October 2020 by Karnel Erickson
2. Unofficial Guide to Ethical Hacking, Ankit Fadia
3. Ethical Hacking,Ankit Adia, Second edition, 2006, Macmillan India Ltd.
4. Penetration Testing: A Hands-On Introduction to Hacking Paperback – Illustrated, 14 June 2014 Georgia Weidman (Author)
5. Beginner to Expert Guide to Computer Hacking, Basic Security, and Penetration Testing James Patterson
6. Cyber Law Crimes, Barkhs and U. Rama Mohan, Third Edition, 2017, Asia Law House
7. Cyber Laws Simplified, ViveekSood, Fourth reprint 2008, McGraw Hill.
8. URL: https://www.infosectrain.com/blog/phases-of-ethical-hacking

Mahatma Gandhi University
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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	INTERNSHIP					
Type of Course	**INT**					
Course Code	**MG4INTADS200**					
Course Level	**200 – 299.**					
Course Summary	A key aspect of the new MGU UGP programme is induction into actual work situations. All Students will undergo internships in a firm, industry, or organization or training in labs with faculty and researchers in their own or other institutions during the summer vacation.					
Semester	**IV**	Credits			2	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
Pre-requisites, if any	Basic knowledge of programming and understanding of computer science concepts.					

SEMESTER V

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Computer Networks**					
Type of Course	**DSC A**					
Course Code	**MG5DSCADS300**					
Course Level	**300- 399**					
Course Summary	To provide an understanding of signals, transmission media, network models, switching, routing, and IP protocols, while equipping students to analyze data transfer methods and apply networking tools to configure and simulate network environments.					
Semester	**V**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand signals, transmission media, network topologies, and layered network models.	U	1,2,4,10
2	Analyze switching techniques and error control methods to improve reliable data transfer.	An	1,2,3,10
3	Analyze routing methods, IP protocols, and common application layer services.	An	1,2,3,10
4	Understand various Application Layer Protocols	U	1,2,4, 10

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Signals-Analog Signals,Digital Signals-Signal Impairment-Attenuation and Amplification,Distortion,Data Rate Limits-Nyquist Bit Rate and Shannon Capacity-Multiplexing-FDM, TDM,Transmission Media- Guided and Unguided media	5	1
	1.2	Networks-Network Criteria, Type of Connection, Physical Topology-Bu,Star,Ring and Mesh-Network Types-LANs and WANs	5	1
	1.3	TCP/IP Protocol Suite-Layered Architecture,Description of Layers,ISO/OSI Model	5	1
2	2.1	Switching-Circuit Switched Network-Three Phases-Datagram Networks,Virtual Circuit Networks	5	2
	2.2	Error Detection and Correction-Types of Errors,CRC, Checksum	5	2
	2.3	Framing, Flow control and Error control Noisy and Noiseless channel protocols-stop and wait ARQ, goback-n ARQ,Selective Repeat	5	2
3	3.1	Connecting Devices-Routing- Unicast routing protocols-Distance Vector Routing,Link State Routing	5	3
	3.2	IPV4, IPV6	5	3
	3.3	Transport Protocols- UDP, TCP	5	3
4	4.1	Application Layer Protocols- FTP, SMTP , Telnet, Remote Login	8	4
	4.2	WWW , HTTP , DNS,URL	7	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks** **Written Test / Seminar / Viva/ Assignments**

	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1.Behrouz A. Forouzan, Data Communications and Networking, 4th Edition, McGraw-Hill, 2007.
2.Andrew S. Tanenbaum, Computer Networks, 5th Edition, Pearson, 2010.

Mahatma Gandhi University

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Programme	**BSc (Honours) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**				
Course Name	**PROBABILITY AND INFERENTIAL STATISTICS**				
Type of Course	**DSC A**				
Course Code	**MG5DSCADS301**				
Course Level	**300-399**				
Course Summary	This course explores a strong foundation in Probability and to provide students with knowledge of statistical concepts of Correlation and Regression. Upon successful completion of the course, students will possess the ability to apply statistical methods effectively for data analysis and informed decision-making.				
Semester	**V**	Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	0	0	0	60
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Students will be able to understand and apply the fundamental principles of probability. They will be able to define and distinguish between classical, empirical, and axiomatic approaches to probability, and Students will also be able to apply Bayes' theorem to solve real-life problems involving conditional probability.	U	1
2	Analyse the relationship between variables using scatter diagrams and various correlation techniques, including Karl Pearson's and Spearman's	An	1,2

	methods, and interpret the strength, direction, and reliability of correlation using coefficient of correlation, probable error, and coefficient of determination.		
3	Understand and analyse various regression techniques to analyse relationships between variables, construct regression lines using graphical and least squares methods, derive regression equations, and interpret the relationship between correlation and regression coefficients.	An	1,2
4	Understand the concept of point estimation. Compare different estimators based on their statistical properties..	U	2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT
Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Basic concepts of probability: Random experiment, Sample space, outcome, events, types of events, operations with events.	4	1
	1.2	Definition of probability: Classical, empirical & axiomatic definitions, Addition theorem (up to 3 events).	5	1
	1.3	Conditional probability: independent events, multiplication theorem (up to 3 events) Baye's theorem and its applications.	6	1
2	2.1	Correlation: Relation between variables, Scatter diagram, definition of correlation, Types of correlation, Degree of correlation.	4	2
	2.2	Coefficient of correlation, Methods for calculating coefficient of correlation: Karl Pearson's correlation coefficient, Spearman's rank correlation coefficient.	7	2
	2.3	Probable error, Interpretation of coefficient correlation on the basis of PE, Coefficient of Determination.	4	2
3	3.1	Regression: Definition, Different types of Regression,	2	3
	3.2	Regression line, Methods of drawing regression line: Free hand curve method, method of least square,	4	3
	3.3	Regression equations: regression equation of x on y and y on x.	5	3
	3.4	Relationship between correlation coefficient and Regression coefficient, Difference between correlation and Regression.	4	3
	4.1	Estimation of parameters – point estimation , interval estimation	5	4

4	4.2	Properties of point estimation- unbiasedness, efficiency, consistency, sufficiency	5	4
	4.3	Method of estimation – method of moments and method of maximum likely hood	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks** **Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **Written Test - 70 Marks - Duration 2 Hours** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Gupta, S. C. and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand and Sons
2. Gupta, S.P. (2021) Statistical Methods, 46th Edition, Sultan Chand and Sons: New Delhi
3. Beverly J. Dretzke. (2008). Statistics with Microsoft Excel, 4th Edition, Pearson.

Suggested Readings:

1. Medhi, J. (2006) Statistical Methods, 2nd Edition, New Age International Publishers.
2. Mukhopadhyay, P. (1999). Applied Statistics, New Central Book Agency Private Limited, Kolkata.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**				
Course Name	**Mobile and Wireless Security (System Security Specialization)**				
Type of Course	**DSE**				
Course Code	**MG5DSEADS300**				
Course Level	**300 - 399**				
Course Summary	To cover network and wireless security fundamentals, including Bluetooth and IrDA architecture, CIA principles, access control, cryptography, intrusion detection, penetration testing, WEP encryption, WLAN configuration, and IEEE 802.11 standards for evaluating and securing wireless networks.				
Semester	**V**	Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial / Practical	Others	
		4	0 / 0	0	60
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand various network technologies	U	1
2	Understand Bluetooth system architecture, IrDA and Understand the principles of CIA, certification, access control models, and basic cryptographic technologies.	U	1,6,8
3	Understand and Analyze various intrusion detection methods, penetration testing techniques,	An	1,2
4	Apply WEP encryption, decryption, and authentication methods to secure wireless communication and Apply WLAN configurations, IEEE 802.11 standards, and exploitation analysis techniques to evaluate wireless network security.	A	1,3,5

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Network Technologies-PAN,LAN,MAN,WAN-Wireless Theory-Wireless Cellular Technologies-Wireless Transmission Systems-The Generation Gap	5	1
	1.2	Spread Spectrum Technology-Direct Sequence Spread Spectrum (DSSS),Frequency-Hopping Spread Spectrum (FHSS),Orthogonal Frequency Division Multiplexing	5	1
	1.3	Cellular Technology-Cellular Network Elements,The Call Process-IEEE 802.11 Specifications for Wireless LANS-802.11 Wireless Network Operational Modes-Adhoc Mode and Infrastructure Mode	5	1
2	2.1	Bluetooth-System Architecture Features-The Piconet-Bluetooth Hardware Elements-Battery Conservation-Bluetooth Security-Infrared Data Association (IrDA)	5	2
	2.2	Concepts of C.I.A.-Certification and Accreditation-Information Classification Concepts-Identification and Authorization,Access Control Models- Mandatory, Discretionary, Nondiscretionary Access Control, Accountability	5	2
	2.3	Cryptographic Technologies-Secret Key Cryptography (Symmetric Key),Public (Asymmetric) Key Cryptosystems	5	2
3	3.1	Intrusion Detection Systems-Network Based IDS, Host Based IDS,IDS Detection Methods-Signature Based IDS,Statistical Anomaly-Based IDS,Penetration Testing	5	3
	3.2	Threats and Solutions-Security Threats to Personal Electronic Devices,Wireless Network Threats-802.11 Vulnerabilities,Service Set Identifier Problems , Eavesdropping, Transmission Alteration and Manipulation, Denial-of-Service Attacks,War Driving	5	3
	3.3	Standards and Policy Solutions -PDA Security Policies,User Security Awareness,Physical Hardware Security-BIOS Passwords, Biometrics and Smart Cards, BlackBerry Security	5	3
4	4.1	Wired Equivalent Privacy-WEP Encryption,WEP Decryption,WEP RC,WEP Authentication Methods-Open System Authentication,Shared Key Authentication	5	4
	4.2	WLAN Configurations- Independent basic service system.,Infrastructure basic service set-The IEEE 802.11 Physical (PHY) Layer, IEEE 802.11 Media Access Control Frame Formats-General Frame Format,IEEE 802.11 Management Frame Type	5	4
	4.3	Systematic Exploitation of an 802.11b WLAN,Systematic Exploitation-Reconnaissance, Access	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **Written Test - 70 Marks - Duration 2 Hours** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1.Wireless Security Essentials: Defending Mobile from Data Piracy, Russel Dean Vines, First Edition, 2002, John Wiley & Sons,.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**				
Course Name	**Embedded Robotics (Robotics Specialization)**				
Type of Course	**DSE**				
Course Code	**MG5DSEADS301**				
Course Level	**300-399**				
Course Summary	To Introduces the fundamental principles of embedded systems and microcontrollers, with a focus on AVR architecture, CPU components, and embedded hardware. It explores the role of embedded controllers in mobile robotics, including synchronization and interrupt handling, and examines wireless communication and the design of omni-directional robotic systems.				
Semester	**V**	Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	0	0	0	60
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Explain the fundamental concepts of embedded systems, including embedded processors, hardware units, devices, and the design process involved in developing embedded systems.	U	1,2, 10
2	Explain the characteristics and applications of microcontrollers in embedded systems, distinguish microcontrollers from general-purpose microprocessors, and describe the architecture, features, and peripherals of the AVR microcontroller family.	U	1, 2, 3

3	Describe the key components of mobile robots and embedded controllers, explain the functions of the Central Processing Unit (CPU) including logic gates, registers, ALU, control unit, and discuss synchronization, scheduling, interrupts, and timer-activated tasks.	A	1, 2, 3
4	Explain the principles of wireless communication including fault-tolerant self-configuration, user interfaces, and remote control; describe the design and kinematics of Omni-directional robots, including Mecanum wheels, drive mechanisms, and control programming.	A	2, 3, 9, 9
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Embedded System-Embedded Systems, Processors Embedded into a System,	4	1
	1.2	Embedded Hardware units and Devices in a system	7	1
	1.3	Design Process in Embedded System	4	1
2	2.1	The AVR Microcontroller: Microcontrollers and embedded processors, Microcontroller versus general-purpose microprocessor, Microcontrollers for embedded systems, Mechatronics and microcontrollers	5	2
	2.2	Overview of the AVR family AVR features, Simplified View of an AVR Microcontroller, AVR microcontroller data RAM and EEPROM, AVR microcontroller l/O pins, AVR microcontroller peripherals, AVR family overview	10	2
3	3.1	Robots and Controllers Mobile Robots, Embedded Controllers, Interfaces, Operating System	5	3
	3.2	Central Processing Unit-Logic Gates, Function Units, Registers and Memory, Retro, Arithmetic Logic Unit, Control Unit, Central Processing Unit,	5	3
	3.3	Synchronization, Scheduling, Interrupts and Timer-Activated Tasks	5	3
4	4.1	Wireless Communication Messages, Fault-Tolerant Self-Configuration, User Interface and Remote Control	8	4

	4.2	Omni directional Robots Design Mecanum Wheels, Omni-Directional Drive, Kinematics, Omni-Directional Robot Design, Driving Program	7	4
5		Teacher Specific content..		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **Written Test - 70 Marks - Duration 2 Hours** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Embedded System – Architecture, Programming, Design by Rajkamal Tata Mc Graw Hill, 2011

2.The AVR microcontroller and embedded system using assembly and c by MUHAMMAD ALI MAZIDI, SARMAD NAIMI, AND SEPEHR NAIMI

3. Embedded Robotics Mobile Robot Design and Application with Embedded Systems by Thomas Bräunl Third Edition

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**IoT Storage - Cloud Computing (Internet of Things Specialization)**					
Type of Course	**DSE**					
Course Code	**MG5DSEADS302**					
Course Level	**300-399**					
Course Summary	This course provides a comprehensive introduction to cloud computing concepts, virtualization, cloud architecture, data-intensive computing, and practical exposure to cloud platforms and applications.					
Semester	**V**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic knowledge of computer networks, operating systems, and programming concepts.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Explain the fundamental concepts of cloud computing, computing platforms, and the principles of parallel and distributed computing.	U	1
2	Describe virtualization, its types, characteristics, and the relationship between virtualization and cloud computing.	U	2
3	Understand and differentiate the components of cloud architecture (IaaS, PaaS, SaaS) and cloud types with economic perspectives.	An	3
4	Apply cloud programming tools like Aneka and MapReduce to solve real-world data-intensive computing problems using cloud platforms like AWS and GAE.	A	5

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction: Introduction to Cloud Computing, Computing Platforms and Technologies.	3	1
	1.2	Principles of Parallel And Distributed Computing	3	1
	1.3	Eras of Computing, Parallel vs. Distributed Computing.	4	1
	1.4	Elements of Parallel Computing.	4	1
2	2.1	Virtualization: Introduction, Types, characteristics of virtualized environment.	5	2
	2.2	Virtualization and Cloud Computing, Pros and Cons of Virtualization.	5	2
	2.3	Cloud Computing Architecture: Introduction, Cloud Reference Model-Iaas ,SaaS,PaaS.	5	2
	2.4	Types of Clouds, Economics of the Cloud.	5	2
3	3.1	Aneka: Cloud Application Platform: Framework Overview, Anatomy of the Aneka Container	3	3
	3.2	Building Aneka Clouds, Cloud Programming and Management,	4	3
	3.3	Data Intensive Computing: Introduction, Technologies for data intensive computing, Map-Reduce Programming.	4	3
4	4.1	Cloud Platforms in Industry: Amazon Web Services, Google AppEngine.	5	4
	4.2	Cloud Applications Scientific Applications,	5	4
	4.3	Business and Consumer Applications	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks Written Test / Seminar / Viva/ Assignments**

	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

BOOK OF STUDY:

1. Rajkumar Buyya, Christian Vecchiola, S ThamaraiSelvi- Mastering Cloud Computing, Tata McGraw Hill Publications.

REFERENCES:

1.Kumar Saurabha,"cloud computing" Wiley Publication Krutz,Vines "cloud Security".Wiley Publications.

2. A Srinivasan & J.Suresh "cloud computing":A practical approach for learning and Implementation ",First Edition pearson.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Augmented Reality and Virtual Reality**					
Type of Course	**DSE**					
Course Code	**MG5DSEADS303**					
Course Level	**300 - 399**					
Course Summary	To Introduce the foundational concepts and technologies of Virtual Reality (VR), Augmented Reality (AR), and related extended realities, covering their core components, interaction modalities, current challenges, and hardware requirements					
Semester	**V**	Credits			**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	**60**
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Define and explain the core concepts of Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), Augmented Virtuality (AV), and Extended Reality (XR); identify and describe key interaction features such as audio, controllers, touch, gaze, voice, hand tracking, and motion controllers.	U	1,2,3,10
2	Recognize and evaluate current issues and limitations in Augmented Reality (AR) technology, including form factors, cost, tracking, field of view, and	An	1,2,10

	adoption rates; explore and compare consumer-grade AR platforms such as Microsoft HoloLens, Meta 2, Magic Leap, and Mira Prism.		
3	Describe the key characteristics of Augmented Reality (AR), differentiate it from Virtual Reality (VR), explain how AR technology functions, and identify the hardware components and devices required to support AR experiences.	U	1,2,3
4	Illustrate the applications and impact of Virtual and Augmented Reality across major industries such as travel, education, aerospace, retail, and marketing; explore and demonstrate the use of current mobile AR applications like Google Translate, Pokémon Go, and Amazon AR View.	An	1,2,3, 9
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Defining Virtual and Augmented Reality, Introducing Virtual Reality and Augmented Reality, Mixed reality, Augmented virtuality, Extended reality	8	1
	1.2	Focusing on Feature-Audio, Considering Controllers, Touch, Gaze, Keyboard and mouse, Voice, Hand tracking, Motion controllers	7	1
2	2.1	Recognizing the Current Issues with Augmented Reality-Form factors and first impressions, Cost and availability, Perceived usefulness, Tracking, Field of view, Visuals, Assessing Adoption Rates	8	2
	2.2	Consuming Content in Augmented Reality-Exploring Consumer-Grade Augmented Reality, Microsoft HoloLens, Meta 2, Magic Leap, Mira Prism	7	2
3	3.1	Augmented Reality Characteristics, Difference between Augmented Reality and Virtual Reality, How Augmented Reality Works with Technology	8	3
	3.2	Hardware Components to Power Augmented Reality: The Hardware Needed to View AR Content, Hardware Requirements, Augmented Reality Devices	7	3
4	4.1	Virtual and Augmented Reality The Next Frontier for Major Industries: Travel, Museums, Aerospace, Retail, Military, Education, Advertising and Marketing	7	4
	4.2	Mobile Apps for Experiencing Augmented Reality Today: Google Translate, Amazon AR View, AR City, Ingress and Pokémon Go, Sketch AR, Find Your Car and Car Finder AR	8	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **Written Test - 70 Marks - Duration 2 Hours** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Virtual & Augmented Reality For Dummies by Paul Mealy
2. Innovating with Augmented Reality Applications in Education and Industry by P. Kaliraj T. Devi

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Data Mining And Data Warehousing**					
Type of Course	**DSE**					
Course Code	**MG5DSEADS304**					
Course Level	**300 - 399**					
Course Summary	This course introduces the core concepts and techniques of Data Mining and Data Warehousing, focusing on extracting useful patterns, associations, classifications, and clusters from large datasets. It covers data pre-processing, frequent pattern mining (e.g., Apriori), classification methods (e.g., decision trees, Bayesian), clustering (e.g., K-means), and the integration of data mining with OLAP and data warehouse systems.					
Semester	V	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand core concepts of **data mining** and its functionalities such as **characterization**, **discrimination**, and **frequent pattern mining**. They will be able to apply techniques for **association rule mining**, **classification, prediction,** and **clustering.**	U	1,2
2	Understand and apply key concepts of association rule mining and classification, including support, confidence, and advanced algorithms	U	1

	like Apriori, to discover meaningful patterns and correlations in large datasets.		
3	classification and prediction using techniques like decision trees and Bayesian classifiers, and apply clustering methods such as K-means and K-medoids for analysing and grouping data effectively.	An	2,3
4	Understand the architecture, design principles, and implementation of data warehouses, differentiate between OLTP and OLAP systems, and explore their integration with data mining techniques.	U	1
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction Data Mining, Data Mining Functionalities Characterization and Discrimination, Mining frequent patterns	5	1
	1.2	Classification and Prediction, , Classification of Data Mining Systems,	5	1
	1.3	Data Mining Task Primitive, Integration of Data Mining systems, Data integration and transformation, Data reduction, Data Pre-processing.	5	1
2	2.1	Association Rules and Classification Concepts , Support and Confidence	5	2
	2.2	Efficient and Scalable Frequent item set Mining methods, Mining various kind of association rules	5	2
	2.3	Apriori Algorithm From association mining to Co-relation analysis	5	2
3	3.1	Classification and prediction, Issues, Classification by Decision tree induction, Bayesian Classification	4	3
	3.2	Cluster Analysis Definition, Types of data in cluster analysis, Clustering methods-Partitioning methods, K-means and k-medoids	8	3
4	4.1	Data Warehouse and OLAP technology ,Comparative study of OLTP and OLAP	9	4
	4.2	Data warehouse architecture, Design –Guidelines for Data Warehouse Implementation	9	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Data Mining :Concepts and Techniques Jiawei Han and Micheline Kamber(2006) (2nd ed.).Elsevier

SUGGESTED READINGS

1. Data Mining Practical Machine Learning Tools and Techniques,Witten and Frank,2nd ed. Elsevier,2005
2. Data Mining Theory and Practice, Soman, Divakar and Ajay,PHI, 2006
3. Data Mining:Introductory and Advanced Topics, Margaret H Dunham,Person

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Programme	**BSc(Hons) ARTIFICIAL INTELLIGENCE AND DATASCIENCE**					
Course Name	**Digital Image Processing**					
Type of course	**DSE**					
Course Code	**MG5DSEADS305**					
Course Level	**300 - 399**					
Course Summary	This course covers the fundamentals of digital image processing, including image acquisition, enhancement, restoration, segmentation, and compression, with emphasis on practical applications and standards like JPEG and MPEG.					
Semester	V	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	**Understand** the fundamental concepts of digital image processing, including image acquisition, sampling, quantization, pixel relationships, and color models	U	1
2	**Analyze** image enhancement techniques in spatial and frequency domains, including gray-level transformations, histogram processing, filtering, and Fourier transforms.	An	2
3	**Apply** image degradation models, restoration methods, noise reduction techniques, and segmentation approaches such as thresholding and region-based methods	A	3
4	**Analyze** efficient image compression techniques using lossless and lossy methods, including predictive coding, transform coding, and standards like JPEG and MPEG.	An	4

Remember(R),Understand(U), Apply(A), Analyse(An), Evaluate(E),Create(C),Skill(S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction(Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction, Steps in image processing ,Image acquisition, representation, sampling and Quantization	4	1
	1.2	Relationship between pixels. Color models.	4	1
	1.3	Basics of color image processing.	3	1
2	2.1	Image enhancement in spatial domain, some basic gray level transformations, histogram processing.	6	2
	2.2	Image enhancement using arithmetic, logic operations, basics of spatial filtering and smoothing.	5	2
	2.3	Image enhancement in Frequency domain , Introduction to Fourier transform: 1- D, 2 –D DFT and its inverse transform, smoothing and sharpening filters.	7	2
3	3.1	Image restoration: Model of degradation and restoration process.	6	3
	3.2	Noise models, restoration in the presence of noise, periodic noise reduction.	6	3
	3.3	Image segmentation: Thresholding and region based segmentation.	7	3
4	4.1	Image compression: Fundamentals , Image compression models , Information theory	5	4
	4.2	Error free compression ,Lossy compression: predictive and transform coding,	4	4
	4.3	Case study: JPEG and MPEG standard.	3	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure(Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment(CCA) 30 Marks** **Written Test / Seminar / Viva/ Assignments**

	B. End Semester Evaluation **Written Test - 70 Marks - Duration 2 Hours** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1.Digital Image Processing , R.C. Gonzalez, R.E.Woods 2nd Edition,2002, Pearson Education.
2. Fundamentals of Digital image Processing , Anil K. Jain,2nd Edition, 1994, Prentice Hall of India.
3. Digital Image Processing, Pratt. W.K., 3rd Edition, John Wiley & Sons. 4. Digital Picture Processing, vol .I & II, Rosenfled A. &Kak, A.C,1992,Academic Press.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Software Development Lab 1 - Mini Project**					
Type of Course	**SEC**					
Course Code	**MG5SECADS300**					
Course Level	**300 - 399**					
Course Summary	The aim of the project is to test the independent research skills students have acquired during their time at University/College.					
Semester	**V**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		1	0	2		75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course , the students will be able to:	Learning Domains *	PO No
1	Design research problem and align research objective	A	1,2,3,8
2	Demonstrate skills in literature review, data collection, analysis	A	1,2,3
3	Interpret the findings in relation to research objective	A	1,2,3
4	Communicates clearly and effectively, both verbally, visually and in writing	A	1,2,3,4

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Design.	75	1

2	2.1	Literature Review, data collection, analysis		2
3	3.1	Interpretation, Implementation		3
4	4.1	Documentation		4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks** **i. Review 1** **ii. Review 2** **Experiments and Results** **Presentation and Viva Voce**
	B. End Semester Evaluation **Practical Examination 50 Marks** **a. Demonstration** **b. Viva** **c. Record**

SEMESTER VI

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Programming with R**					
Type of Course	**DSC A**					
Course Code	**MG6DSCADS300**					
Course Level	**300-399**					
Course Summary	This course equips students with foundational skills in R programming, covering data structures, control flow, functions, basic statistics, data import/export, and package management for effective data analysis.					
Semester	**VI**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand R and RStudio to write, source, and manage R scripts, create and manipulate vectors, perform vectorized operations, and handle numerical data including logical values, infinity, and missing data.	U	1
2	Able to manipulate text and categorical data, work with multi-dimensional data structures such as matrices, arrays, data frames, and lists in R, and perform data extraction, modification, and calculations efficiently.	An	2
3	Analyse control structures and functions in R to create logical programs, manage arguments and return values, and compute basic statistical measures for effective data analysis.	An	2
4	Analyze how to import and export data in R, manage various data types , file operations and packages for enhanced data analysis capabilities.	An	1

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction: History of R- Benefits of Using R - Working with code Editor: RStudio - Starting your First R Session - Sourcing a script - Navigating the workspace	5	1
	1.2	Vectors: Creating vectors - Discovering the properties of vector-combing vectors repeating vector - Getting values in and out of vectors- working with logical vectors	5	1
	1.3	Math with Vector functions working with numbers, infinity and missing values	5	1
2	2.1	Using character vector for text data - Manipulating text - Factoring in Factors -Working with more dimensions	5	2
	2.2	Adding a second dimension - Using the indices -Naming matrix rows and columns - Calculating with matrices Adding more dimensions	4	2
	2.3	Creating an array - Combining different types of values in Data Frame - Manipulating values in a Data Frame- List: Creating a list – Extracting elements from lists - Changing elements in lists	6	2
3	3.1	Control Structures: Conditional control structures: if statement - if..else statement - switch statement - Loops: for, while and repeat loops - break and next statement.	5	3
	3.2	Functions: The Function Keyword - Arguments - Return Values- Functions as Arguments - Anonymous Function	6	3
	3.3	Anonymous Functions-Properties of Functions -Argument Order and Named Arguments. Computing basic statistics: mean, median, mode, correlation and covariance.	4	3
4	4.1	• To perform the basic mathematical operation in R programming. • To get the input and perform numerical operations (MIN, MAX, AVG,SUM, SQRT, ROUND)	10	4
	4.2	• Implementation of vector data operations in R • Implementation of various control structures in R.	10	4
	4.3	• Implementation and use of data frames in R • To get the matrix and perform Matrix addition, subtraction, multiplication, inverse, transpose and division operations using vector concept in R..	10	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a) Demonstration** **b) Viva** **c) Record**

REFERENCES

1. R for Beginners -Emmanuel Paradis.
2. "R Programming for Dummies", WileyAndrie Devries and Jorismeys, Publications, Isbn:978-81-265-5201-6. (Unit 1 : chapter-2,3,4) (Unit 4:chapter 12,14) (Unit 2 chapter 5,6,7)
3. "Beginning R- The Statistical Programming Language",Dr. Mark Gardener, Wiley Publications, Isbn: 978-81-265-4120-1.
4. "R Cook Book",Paul Teetor, O'relly Publications, First Edition, 2011, Isbn: 978-0-596-80915-7 (Unit 5: Chapter 10)
5. Joseph Adler, "R In Nutshell A Desktop Quick Reference",Isbn:978-0-596- 80170-0
6. "The Book of R", Tilman M .Davis No Starch Press, 2016 (Unit 3: chapter 10,11,3)
7. "R Programming For Data Science",Roger D. Peng, Leanopub, 2015
8. The Art Of R Programming: A Tour Of Statistical Software Design, Matloff, Norman, And Matloff, Norman S,No Starch Press, 2011.
9. Colin. Efficient R Programming: A Practical Guide to Smarter Programming, Lovelace, Robin, And Gillespie,O'reilly Media, 2016.
10. Learn R Programming In 24 Hours: Complete Guide For Beginners, Alex Nordeen, Guru99, 2020.
11. Beginner's Guide For Data Analysis Using R Programming., Jeeva Jose, KhannaPublishing House,2019

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**MACHINE LEARNING TECHNIQUES**					
Type of Course	**DSC A**					
Course Code	**MG6DSCADS301**					
Course Level	**300- 399**					
Course Summary	To provide a comprehensive introduction to AI, machine learning, and deep learning concepts, covering fundamental models, key algorithms, advanced architectures, and practical implementation using Python.					
Semester	**VI**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the basic concepts of Machine Learning, its types, applications and challenges Understand supervised and unsupervised learning techniques such as regression, classification and clustering	U	1,2
2	Focuses on Feature Engineering Concepts	A	1,2,3
3	Focuses on various Machine Learning Algorithms	An	1,2,3,10
4	Emphasizes hands-on implementation using Python and NumPy And implementing basic machine Learning approaches	A	1,2,4,9

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Machine Learning-Evolution of Machine Learning-What is Machine Learning-How do machines Learn- Well posed Learning Problem-Types of Machine Learning-Supervised, Unsupervised and Reinforcement Learning and their comparison	3	1
	1.2	Supervised Learning- Classification and Regression-Linear Regression-Logistic Regression- Unsupervised Learning-Clustering and Association	4	1
	1.3	Selecting a Model- Predictive models, Descriptive models. Training a model- Holdout method, K- fold cross validation method, bootstrap Sampling	4	1
	1.4	Testing a model- Under fitting and Over fitting-Bias-variance trade off-Confusion matrix-Performance measures-Accuracy, Precision, recall, F measure and ROC curve	4	2
2	2.1	Issues in Machine Learning-Feature Engineering- Feature Transformation-Feature Construction- Feature Extraction	5	2
	2.2	Feature Subset Selection- Issues in High Dimensional Data- Measure of feature selection and redundancy	5	2
	2.3	Feature selection Approaches- Principal Component Analysis- Linear Discriminant Analysis	5	3
3	3.1	KNN Algorithm, Decision Tree, Random Forest, SVM	5	2
	3.2	Finding Pattern using Association Rule, Different types of Clustering, Hierarchical clustering	5	3
	3.3	Ensemble Learning Algorithm, Bagging, Boosting	5	3
4	4.1	Programs using Numpy Python programs to plot **sigmoid, tanh, and ReLU** functions.	10	3
	4.2	Implement linear regression Implement logistic regression Program to show train and test concepts Program to Print confusion matrix	10	3
	4.3	Perform Classification Implement K Nearest Neighbour Implement SVM	10	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks** **B. Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a) Demonstration** **b) Viva** **c) Record**

REFERENCES

1. Saikat Dutt, SubramanianChandramouli, Amit Kumar Das(201), Machine Learning, Pearson
2.Andreas C. Müller & Sarah Guido, Introduction to Machine Learning Using Python, O'Reilly

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Security Threats and Assessment (System Security Specialization)**					
Type of Course	**DSE**					
Course Code	**MG6DSEADS300**					
Course Level	**300-399**					
Course Summary	This course provides an in-depth understanding of security threats, vulnerabilities, and countermeasures, focusing on prevention, detection, response, and management strategies for building secure information systems.					
Semester	**VI**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic knowledge of Computer Networks, Fundamentals of Operating Systems Understanding of Database Management Systems, Introductory knowledge of Cryptography and Network Security					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Identify and analyze various security threats and vulnerabilities in computing infrastructures (wired, wireless, e-commerce, physical).	An	1
2	Apply cryptographic methods, access control techniques, and biometric authentication to secure systems.	A	2
3	Evaluate the effectiveness of intrusion detection systems, antivirus solutions, and risk management tools.	E	3
4	Demonstrate awareness of security management policies, digital rights management, and ethical practices in information security.	E	4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Threats and Vulnerabilities to Information and Computing Infrastructures: Internal Security Threats, , , Hacking Techniques in Wireless Networks,	3	1
	1.2	Physical Security Threats, E-Mail Threats and Vulnerabilities	3	1
	1.3	E-Commerce Vulnerabilities, Hacking Techniques in Wired Networks	4	1
	1.4	Wireless Threats and Attacks: Wireless Threats and Attacks, Cracking WEP, Denial of Service Attacks, Network Attacks, Fault Attacks, Side-Channel Attacks.	3	1
2	2.1	Prevention: Cryptographic Privacy Protection Techniques, Cryptographic Hardware Security Modules, Client-Side Security, Server-Side Security ,Protecting Web Sites, Database Security,	5	2
	2.2	Access Control: Principles and Solutions, Password Authentication ,Computer and Network Authentication,	4	2
	2.3	Antivirus Technology, Biometric Basics and Biometric Authentication	5	2
3	3.1	Detection and Recovery: Intrusion Detection Systems Basics, Host-Based Intrusion Detection Systems , Network-Based Intrusion Detection Systems, ,	3	3
	3.2	Computer Security Incident Response Teams (CSIRTs) , Implementing a Security Awareness Program, Risk Assessment for Risk Management, Security Insurance and Best Practices.	2	3
	3.3	Auditing Information Systems Security, Evidence Collection and Analysis Tools, Information Leakage: Detection and Countermeasures.	4	3
4	4.1	Management and Policy Considerations	10	4
	4.2	Digital Rights Management, Web Hosting, Multilevel Security, Multilevel Security Models,	10	4
	4.3	Guidelines for a Comprehensive Security System.	4	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Information Security, Volume 3, Threats, Vulnerabilities, Prevention, Detection, and Management,HosseinBidgoli,2006, Wiley.
2. 2.Loss Prevention and Crime Prevention ,Lawrence J Fennelly, fourth edition, 2004, Elsevier.
3. 3.Information Security Management Handbook,Harold F. Tipton, Sixth Edition,2010, Auerbach publiations.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Robot Cognition and Navigation (Robotics Specialization)**					
Type of Course	**DSE**					
Course Code	**MG6DSEADS301**					
Course Level	**300 - 399**					
Course Summary	This course introduces the principles of robot cognition and navigation with emphasis on mobile robots. Students will learn perception, mapping, localization, and cognitive navigation strategies.					
Semester	VI	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	This course introduces robot cognition and navigation, focusing on perception, mapping, localization, path planning, and practical tools for autonomous mobile robots.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Explain the fundamentals of robot cognition and sensing mechanisms	U	1
2	Describe and compare mapping techniques for mobile robots	U	2
3	Apply localization and path planning strategies in simple scenario	A	3
4	Analyse cognitive approaches to robot navigation using case studies	An	4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Introduction to the Model of Cognition -** Various States of Cognition - Cycles of Cognition. **Visual Perception -** Human Visual System - Vision for Mobile Robots.	4	1

	1.2	**Visual Recognition -**Template Matching - Feature-Based Model - Fourier Model - Structural Model - The Computational Theory of Marr.	4	1
	1.3	**Machine Learning -** Properties and Issues in Machine Learning - Classification of Machine Learning. **Soft Computing Tools and Robot Cognition -** Modeling Cognition Using ANN (Artificial Neural Networks) - Fuzzy Logic in Robot Cognition - Genetic Algorithms in Robot Cognition.	5	1
2	2.1	Map Building - Introduction - Constructing a 2D World Map – Data Structure for Map Building - Explanation of the Algorithm - Illustration: Procedure Traverse Boundary - Illustration: Procedure Map Building - Robot Simulation .	5	2
	2.2	Path planning -Introduction -Representation of the Robot's Environment– **Path Optimization via the Quadtree Approach - I**ntroduction to the Quadtree - Definition - Generation of the Quadtree.	6	2
	2.3	**Neighbor-Finding Algorithms for the Quadtree - The A* Algorithm for Selecting the Best Neighbor**	4	2
3	3.1	**Introduction - Genetic Algorithms** - Encoding of a Chromosome - Crossover - Mutation - Parameters of a Genetic Algorithm (GA) -Selection- **Navigation by a Genetic Algorithm - F**ormulation of Navigation	6	3
	3.2	**Replanning by Temporal Associative Memory (TAM) -** Introduction to TAM - Encoding and Decoding Process in a Temporal associative Memory - Example in a Semi-dynamic Environment - Implications of Results	5	3
	3.3	Robot Programming Packages - Introduction - robot hardware and software-resources, components - ARIA- ARIA client-server, Robot Communication, opening the connection, ArRobot	6	3
4	4.1	Robot Parameter Display- introduction - flowchart. Program for BotSpeak- introduction -flowchart Gripper control program- introduction- flowchart	5	4
	4.2	Imaging Geometry - Introduction - Necessity for 3D construction- building perception	4	4
	4.3	Building 3D perception using Kalman Filter- introduction- minimal Representation - recursive Kalman Filter-Experiments and Estimation.	6	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

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1. **Patnaik, S.** (2007). *Robot Cognition and Navigation: An Experiment with Mobile Robots*. Cognitive Technologies series. **Springer**, Berlin Heidelberg.
2. Siegwart, R., Nourbakhsh, I.R., & Scaramuzza, D. *Introduction to Autonomous Mobile Robots*, 2nd Edition, MIT Press, 2011.
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4. Dudek, G. & Jenkin, M. *Computational Principles of Mobile Robotics*, 2nd Edition, Cambridge University Press, 2010.
5. Bekey, G.A. *Autonomous Robots: From Biological Inspiration to Implementation and Control*, MIT Press, 2005.
6. Siciliano, B. & Khatib, O. (Eds.). *Springer Handbook of Robotics*, Springer, 2016.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Industrial IoT (Internet of Things Specialization)**					
Type of Course	**DSE**					
Course Code	**MG6DSEADS302**					
Course Level	**300 - 399**					
Course Summary	This course provides a comprehensive overview of Industrial Internet of Things (IIoT), covering its foundations, enabling technologies, architecture, data communication, and real-world applications in modern industrial systems.					
Semester	**VI**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understanding of IIoT, from its historical foundations to current and future technologies, enabling them to design, integrate, and optimize industrial IoT systems in real-world settings.	U	1,2
2	Understand and apply key enabling technologies of IIoT and wireless sensor networks to design and optimize industrial systems.	U	2,3
3	Analyse and integrate sensors, actuators, IIoT architecture, standards, security protocols, and industrial communication networks to design secure, efficient IIoT systems.	An	1,2, 3
4	Implement industrial data acquisition systems, utilizing DCS, PLC, SCADA, and apply IIoT in real-world applications like manufacturing, logistics, healthcare, energy, and predictive analytics.	A	2,3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Foundations, Evolution of industrial revolutions (1.0 to 4.0),	5	1
	1.2	IIoT- Prerequisites of IIoT, Basics of CPS, CPS and IIoT, Applications of IIoT	5	1
	1.3	Design of Industrial Internet Systems, Contemporary Sensing, Features of IIoT for Industrial Processes	4	1
2	2.1	Enabling Technologies of IIoT- Cyber-Physical Systems (CPS), Machine-to-Machine (M2M) Communication,	5	2
	2.2	Off-site Technologies - Cloud Computing and Fog Computing On-site Technologies - Augmented Reality and Virtual Reality	8	2
	2.3	Artificial Intelligence and Machine Learning in IIoT, Role of 5G and Wireless Sensor Networks	5	2
3	3.1	Sensors-Characteristics ,Categories Actuators -Types, IIoT Architecture, Standards, and Security	7	3
	3.2	Industrial Data Transmission-industrial communication protocols like Modbus, Profibus, HART, LoRaWAN, and newer wireless standards (NB-IoT, IEEE802.11ah)	8	3
	3.3	Industrial network layers and integration, Security challenges in IIoT systems	4	3
4	4.1	Industrial Data Acquisition-Introduction, Distributed Control System, Components, PLC, Components, SCADA, Components	5	4
	4.2	Applications - IIoT in manufacturing, logistics, healthcare, energy, Smart maintenance and predictive analytics	4	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks** **Written Test / Seminar / Viva/ Assignments**

	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1.Introduction To Industrial Internet Of Things And Industry 4.0 -Sudip Misra Chandana Roy Anandarup Mukherjee
2.Industry 4.0, The Industrial Internet Of Things-Alasdair Gilchrist

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	Generative AI					
Type of Course	**DSE**					
Course Code	**MG6DSEADS303**					
Course Level	**300-399**					
Course Summary	This course introduces the fundamentals of generative modelling and deep learning, focusing on probabilistic models and advanced techniques like Generative Adversarial Networks (GANs) and Wasserstein GAN					
Semester	**VI**	**Credits**			**4**	**Total Hours**
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic understanding of machine learning, probability, and neural networks.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the fundamentals of generative and discriminative modelling	U	1
2	Implement and analyse probabilistic generative models like Naive Bayes	An	2
3	Build and train basic and advanced GAN architectures, tackling common challenges	A	4
4	Analyse transformer-based models and understand their role in modern generative modelling	An	6

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction Generative Modelling: Generative Versus Discriminative Modelling - Advances in Machine Learning-The Rise of Generative Modelling	3	1
	1.2	The Generative Modelling Framework - Probabilistic Generative Models - Hello World!	3	1
	1.3	Understand Probabilistic Generative Model - Naive Bayes - Hello World! Continued	4	1
	1.4	The Challenges of Generative Modelling - Representation Learning - Setting Up the Environment.	4	1
2	2.1	Deep Learning : Structured and Unstructured Data – Deep Neural Network Keras and Tensor Flow	5	2
	2.2	First Deep Neural Network – Loading the Data – Building , Compiling, training and evaluating the model	5	2
	2.3	Improving the model – Convolutional Layers – Batch Normalization – Dropout Layers	6	2
3	3.1	Generative Adversarial Networks : Introduction to GANs - Building First GAN - The Discriminator - The Generator - Training the GAN - GAN Challenges	7	3
	3.2	Oscillating Loss - Mode Collapse - Uninformative Loss - Hyper parameters - Tackling the GAN Challenges	7	3
	3.3	Wasserstein GAN - Wasserstein Loss - The Lipchitz Constraint - Weight Clipping - Training and analysing WGAN	7	3
4	4.1	WGAN-GP - The Gradient Penalty Loss	3	4
	4.2	Transformer Networks The Transformer - Positional Encoding - Multithread Attention - The Decoder - Analysis of the Transformer - BERT – GPT	6	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks** **Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **Written Test - 70 Marks - Duration 2 Hours** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. David Foster, Generative Deep Learning-Teaching Machines to Paint, Write, Compose, and Play, O'Reilly, 2019

2. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press, 2016

3. Jakub Langr and Vladimir Bok, GANs in Action: Deep learning with Generative Adversarial Networks, Manning,2019

4. Magnus Ekman, Learning Deep Learning: Theory and Practice of Neural Networks, Computer Vision, Natural Language Processing, and Transformers Using TensorFlow, Addison-Wesley Professional, 1st edition 2021

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Big Data Analysis**					
Type of Course	**DSE**					
Course Code	**MG6DSEADS304**					
Course Level	**300-399**					
Course Summary	This course introduces the concepts, tools, and technologies of big data processing and analytics using platforms such as Hadoop, Hive, Pig, MongoDB, and MapReduce.					
Semester	**VI**	**Credits**			**4**	**Total Hours**
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic knowledge of Bigdata, programming, and data structures is required.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the classification of digital data and the key characteristics and challenges of Big Data.	U	1, 2
2	Compare traditional Business Intelligence with Big Data technologies like Hadoop and NoSQL.	An	2, 3
3	Apply data analytics techniques using Hadoop ecosystem components such as HDFS, YARN, MapReduce, Hive, and Pig.	A	3, 4
4	Create data management and processing solutions using MongoDB and evaluate their effectiveness in Big Data scenarios.	C	4, 5

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Classification of Digital Data, Structured and Unstructured Data. Introduction to Big Data: Characteristics , Evolution, Definition - Challenges with Big Data , Other Characteristics of Data	5	1
	1.2	Why Big Data - Traditional Business Intelligence versus Big Data, Data Warehouse and Hadoop.	3	1
	1.3	Environment Big Data Analytics: Classification of Analytics ,Challenges - Big Data Analytics	3	1
2	2.1	NoSQL, Comparison of SQL and NoSQL, Hadoop -RDBMS Versus Hadoop - Distributed Computing Challenges	3	2
	2.2	Hadoop Overview , Hadoop Distributed File System , Processing Data with Hadoop.	3	2
	2.3	Managing Resources and Applications with Hadoop YARN , Interacting with Hadoop Ecosystem.	3	2
3	3.1	Mongo DB: Why Mongo DB , Terms used in RDBMS and Mongo DB , Data Types , Mongo DB Query Language	4	4
	3.2	Map Reduce: Mapper , Reducer , Combiner , Partitioner , Searching ,Sorting , Compression.	7	4
	3.3	Hive: Introduction , Architecture , Data Types , File Formats ,Hive Query Language Statements . Partitions , Bucketing , Views - Sub-Query , Joins , Aggregations , Group by and Having .	10	4
4	4.1	Implementation, Hive User Defined Function, Serialization and Deserialization.	9	3
	4.2	Pig: Introduction -Features, Pig Latin, Pig Primitive Data ,Execution Modes of Pig ,HDFS Commands , Relational Operators , Eval Function.	10	3
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks** **Written Test / Seminar / Viva/ Assignments**

	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1.Seema Acharya, SubhashiniChellappan, "Big Data and Analytics", Wiley Publications, First Edition,2015

Reference Book:

1. Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, "Big data for dummies", John Wiley &Sons, Inc. (2013)
2. Tom White, "Hadoop The Definitive Guide", O'Reilly Publications, Fourth Edition, 2015
3. Dirk Deroos, Paul C.Zikopoulos, Roman B.Melnky, Bruce Brown, Rafael Coss, "Hadoop For Dummies", Wiley Publications, 2014
4. Robert D.Schneider, "Hadoop For Dummies", John Wiley & Sons, Inc. (2012)
5. Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw Hill, 2012 Chuck Lam, "Hadoop In Action", Dreamtech Publications, 2010

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**				
Course Name	**Applied Cryptography**				
Type of Course	**DSE**				
Course Code	**MG6DSEADS305**				
Course Level	**300-399**				
Course Summary	**This course offers a comprehensive overview of classical and modern cryptographic techniques, protocols, and algorithms for securing communication, data, and digital identities**.				
Semester	VI	Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	0	0	0	60
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand fundamental cryptographic techniques, including symmetric/asymmetric encryption, ciphers, one-way functions, and digital signatures for secure communication.	U	1,2
2	Understand basic and intermediate cryptographic protocols for secure key exchange, authentication, and advanced digital signature schemes.	U	1,2,3
3	Understand key management principles and apply techniques for securing communication and data storage through encryption, compression, encoding, and information destruction.	U	2

4	Analyse classical and modern cryptographic algorithms including DES, RSA, hash functions, key exchange protocols, and digital signature schemes for secure data transmission.	An	2,3,4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction, Substitution Cipher, Transposition Cipher, One Time Pads	5	1
	1.2	Communication Using Symmetric Cryptography, Communication Using Asymmetric Cryptography, Steganography	2	1
	1.3	One Way Functions, Digital Signatures- Digital Signature with Encryption	5	1
2	2.1	Basic Protocols-Key Exchange, Authentication,	4	2
	2.2	Authentication and Key Exchange, Multiple Key Public Key Cryptography, Secret Splitting Protocol	7	2
	2.3	Intermediate Protocols-Time stamping Services	5	2
3	3.1	Key Management-Key Length and Algorithms, Importance of Key Management, Transferring keys, Verifying Keys, Storing Keys, Destroying Keys	5	3
	3.2	Encrypting Communication Channels: - Link-by-Link Encryption, End-to-End Encryption, Encrypting Data for Storage: - Driver Level, File Level Encryption.	5	3
	3.3	Compression, Encoding and Encryption, Detecting Encryption, Hiding Cipher text in Cipher Text, Destroying Information.	5	3
4	4.1	Data Encryption Standard, RSA-Introduction-Examples of RSA-Security of RSA	5	4
	4.2	One way Hash Function-MD5-Secure Hash Algorithm (SHA), Message Authentication Codes	7	4
	4.3	Key Exchange Algorithm-Diffie Hellman Key Exchange -Station to Station Protocol, Encrypted Key Change	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks** **Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Bruce Schneier, *Applied Cryptography: Protocols, Algorithms, and Source Code in C*, John Wiley & Sons, Inc, 2nd Edition, 1996.
2. William Stallings, *Cryptography and Network Security: Principles and Practice*, Sixth Edition, 2013, Pearson.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Data Visualization Tools**					
Type of Course	**SEC**					
Course Code	**MG6SECADS300**					
Course Level	**300-399**					
Course Summary	This course introduces the fundamentals of data visualization, tools and techniques using Excel, Python, and BI tools, and advanced concepts like dashboards, storytelling, ethics, and real-world applications.					
Semester	**VI**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites, if any	Basic knowledge of computers, statistics, and programming (preferably Python) is recommended.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the fundamentals of data visualization, types of data, visualization methods, and design principles.	U	1
2	Apply visualization tools and techniques using Excel, Python (Pandas, Matplotlib, Seaborn), and BI tools like Power BI/Tableau.	A	3
3	Analyse and interpret data using various charts and visualization techniques for effective decision making.	An	4
4	Create interactive dashboards, apply data storytelling concepts, and follow ethical practices in visualization.	C	5

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Fundamentals of Data Visualization**:-** Introduction to Data Visualization, Importance of visualization in AI & Data Science, Types of data and visualization methods.	5	1
	1.2	Principles of visual design, Data visualization workflow, Data preprocessing and preparation.	4	1
	1.3	Types of charts: Bar chart, Line chart, Pie chart, Histogram, Scatter plot, Heat map, Choosing appropriate visualization, Data storytelling concepts.	5	1
2	2.1	Visualization Tools & Techniques-Overview of visualization tools, Spreadsheet visualization using Excel/Google Sheets.	6	2
	2.2	Introduction to Python visualization: Pandas basics, Matplotlib, Seaborn, Introduction to Business Intelligence tools: Power BI / Tableau concepts.	5	2
	2.3	Dashboard fundamentals, Interactive visualization concepts, Visualization ethics and best practices.	5	2
3	3.1	Advanced Visualization Concepts & Applications-Introduction to data storytelling and narrative visualization, Dashboard design principles and types of dashboards, Interactive visualization concepts and real-time dashboards.	5	3
	3.2	Ethical use of data and avoiding misleading visualizations, Visualization best practices: color, layout, labeling, readability, Applications of visualization in Business Intelligence, AI, Healthcare, and Marketing Analytics.	5	3
4	4.1	1. Write a program to import a dataset using Python (Pandas) and display the first 5 rows. 2. Write a program to clean data by removing missing values from a dataset. 3. Write a program to create a basic bar chart in Excelor Python (Matplotlib). 4. Write a program to create a line chart using Matplotlib. 5. Write a program to create a statistical plot (histogram or box plot) using Seaborn. 6.Write a program to perform data exploration using visualization (scatter plot). 7. Write a program to create an **interactive chart using Plotly.** **8.** Write a Python program to create a line chart to show sales data (data storytelling). 9. Write a Python program to create a simple dashboard using two charts (bar chart and pie chart). 10. Write a Python program to create a bar chart using user input values (interactive visualization). 11. Write a Python program to create a well-labeled chart showing student marks (use title, labels, and values).	20	4

5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 15 Marks** **Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B . End Semester Evaluation **Written Test - 35 Marks - Duration 1 Hour** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 15 Marks(Answer any 3 questions out of 4) 3x5 = 15 Marks** **Part C - Essay Type Questions – 10 Marks(Answer any 1 questions out of 2) 1x10 = 10 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

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1.Kieran Healy, Data Visualization: A Practical Introduction, Princeton University Press, 2018, ISBN: 0691181624;
2. Cole Nussbaumer Knaflic, Storytelling with Data: A Data Visualization Guide for Business Professionals, Wiley, 2015, ISBN: 1119002257;
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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**AI Ethics And Governance**					
Type of Course	**VAC**					
Course Code	**MG6VACADS300**					
Course Level	**300 -399**					
Course Summary	This course provides an overview of AI ethics and governance, exploring foundational concepts, legal frameworks, moral questions, social impacts, and cultural perspectives—including Indigenous knowledge—while examining issues like justice, accountability, bias, and the development of trustworthy AI for social good.					
Semester	**VI**	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	0	0	45
Pre-requisites, if any	Basic understanding of artificial intelligence concepts and familiarity with ethical principles or philosophy is recommended as a prerequisite for this course.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand fundamental AI concepts and the ethical importance of AI governance	U	1, 2
2	Analyze ethical challenges like bias, transparency, and accountability in AI systems	An	2, 3
3	Evaluate moral frameworks and legal regulations relevant to AI ethics	E	2, 4
4	Apply multidisciplinary perspectives to develop responsible and trustworthy AI solutions	A	3, 5

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to AI Ethics Introduction – Introduction to Artificial Intelligence – Overview for Law and Regulations	4	1
	1.2	Impacts of AI – Ethics of AI – Approaches in AI Ethics	5	1
	1.3	Rise of AI Ethics AI Ethics – Common Themes and Varieties of Questions – Ethical Questions in AI	5	1
	1.4	AI Ethics Now – AI Ethics Law – Case study: An Indigenous AI Report.	5	1
2	2.1	Concepts and Issues Moral frameworks of Justice in AI – Accountability in Computer Systems – Transparency – Responsibility	6	2
	2.2	Concept of Handoff as a Model – Race and Gender – Autonomy – Troubleshooting AI .	6	2
3	3.1	Perspectives and Approaches Perspectives on Ethics of AI – Computer Science - Engineering – Cognitive Science	6	3
	3.2	Economics – Humanities – Philosophy – Anthropology –	4	3
	3.3	Trustworthy AI – Case study of AI for Social Good	4	3
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks / Seminar / Viva/ Assignments** **Written Test**
	B. End Semester Evaluation **<u>Written Test - 50 Marks - Duration 1 Hour 30 Minutes</u>** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

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1. Markus D. Dubber, Frank Pasquale, Sunit Das, The Oxford Handbook Of Ethics Of AI, Oxford University Press, 2021, ISBN: 019006739X;

2. Paula Boddington, AI Ethics: A Textbook, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer, 2023, ISBN: 9811993815;
3. Mark Coeckelbergh, AI Ethics, The MIT Press Essential Knowledge, The MIT Press, 2020, ISBN: 0262538199; et

SEMESTER VII

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Deep Learning Techniques**					
Type of Course	**DCC**					
Course Code	**MG7DCCADS400**					
Course Level	**400- 499**					
Course Summary	To provide a comprehensive introduction to AI, machine learning, and deep learning concepts, covering fundamental models, key algorithms, advanced architectures, and practical implementation using Python.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Introduces the fundamentals of AI, machine learning, and deep learning, covering historical models, basic neural networks, computational graphs, and essential training techniques.	U	1,2
2	Covers key neural network architectures including shallow models, CNNs, RNNs, and advanced AI topics like reinforcement learning and generative adversarial networks.	A	1,2,3
3	Focuses on core machine learning algorithms such as regression, support vector machines, ensemble methods, and auto encoders used for both supervised and unsupervised learning.	An	1,2,3,10
4	Emphasizes hands-on implementation using Python and Numpy for building and training basic neural models and performing key operations like gradient descent and activation functions.	A	1,2,4,9

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Artificial intelligence, machine learning, and deep learning-Learning representations from data, Before deep learning: a brief history of machine learning-Probabilistic modeling,Early neural networks, Kernel methods, Decision trees, random forests, and gradient boosting machines	3	1
	1.2	An Introduction to Neural Networks- Humans Versus Computers: Stretching the Limits of Artificial Intelligence-The Basic Architecture of Neural Networks-Single Computational Layer: The Perceptron, Multilayer Neural Networks	4	1
	1.3	The Multilayer Network as a Computational Graph, Training a Neural Network with Back propagation	4	1
	1.4	Practical Issues in Neural Network Training-The Problem of Over fitting, The Vanishing and Exploding Gradient Problems, Difficulties in Convergence, Local and Spurious Optima	4	2
2	2.1	Common Neural Architectures-Simulating Basic Machine Learning with Shallow Models, Radial Basis Function Networks, Restricted Boltzmann Machines	5	2
	2.2	Recurrent Neural Networks, Convolutional Neural Networks, Hierarchical Feature Engineering and Pretrained Models	5	2
	2.3	Advanced Topics-Reinforcement Learning, Separating Data Storage and Computations, Generative Adversarial Networks,	5	3
3	3.1	Linear regression, Logistic regression, Support vector machine	5	2
	3.2	Ensemble Methods-Bagging and Subsampling, Parametric Model Selection and Averaging, Randomized Connection Dropping, Dropout	5	3
	3.3	Auto encoder: Basic Principles, Autoencoder with a Single Hidden Layer, Deep Auto encoders, Unsupervised Pretraining	5	3
4	4.1	Programs using NumPy, Python programs to plot **sigmoid, tanh, and ReLU** functions.	10	3
	4.2	Write a Python program to generate **random weights and biases** for a small neural network., Python program to fit a straight line (`y = wx + b`) using gradient descent, Write a Python program to perform a **forward pass** of a single neuron (linear model)	10	3
	4.3	Write a Python program to perform a **forward pass** of a single neuron (linear model). Implement linear regression	10	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1.Charu. C. Aggarwal,(2018). *Neural Networks and Deep Learning: A Textbook*. Springer.

2.Zhang, A., Lipton, Z. C., Li, M., & Smola, A. J. (2023). *Dive into Deep Learning* (Release 0.14.3). Cambridge University Press.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Computer Vision**					
Type of Course	**DCC**					
Course Code	**MG7DCCADS401**					
Course Level	**400-499**					
Course Summary	This course introduces the fundamental principles and techniques of computer vision, covering image representation, transformations, enhancement, feature extraction, pattern recognition, basic machine learning concepts, and real-world applications such as face recognition, motion tracking, and robotics.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre -requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the fundamental concepts of computer vision, including image representation, colour models, graphics pipeline, and basic 2D transformations.	U	1
2	Apply basic image processing techniques such as feature detection, feature matching, and pre-processing on image datasets.	A	2
3	Analyse basic AI concepts, image classification methods, and the working of neural networks and CNNs.	An	3
4	Apply computer vision techniques for face and object detection and image classification, utilize graphics for effective visualization, and implement basic image processing solutions using relevant libraries and tools.	A	3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Computer Vision, simple real-life applications	5	1
	1.2	Images and pixels, resolution, grayscale and color images, Basic idea of RGB color model, image formats, viewing images	5	1
	1.3	Graphics pipeline overview, raster graphics, vector graphics, basic 2D transformations, translation, rotation, scaling	5	1
2	2.1	Basic Image Concepts:- What are image features (edges, corners – basic idea only)	5	2
	2.2	Simple idea of feature matching and pattern recognition	5	2
	2.3	Image datasets, basic pre-processing (resize, simple changes)	5	2
3	3.1	Introduction to AI & Image Classification:- What is AI and Machine Learning (very basic concepts)	5	3
	3.2	Image classification (how computers identify images)	4	3
	3.3	Introduction to neural networks, introduction to CNN (Convolutional Neural Networks), layers in CNN, applications in image recognition	6	3
4	4.1	Face detection, object detection, image classification applications, real-world AI use cases	5	4
	4.2	Role of Computer Graphics in visualization, data visualization basics, image visualization techniques	5	4
	4.3	Introduction to image processing libraries, basic implementation concepts, introduction to OpenGL, WebGL (overview), simple image processing programs	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) - 30 Marks** **Written Test / Seminar / Viva/ Assignments**

	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, 2nd Edition, Springer, 2022.
2. Simon J. D. Prince, *Computer Vision: Models, Learning, and Inference*, 1st Edition, Cambridge University Press.
3. *Digital Image Processing,* Rafael C. Gonzalez & Richard E. Woods, Fourth Edition, Pearson Education
4. *Computer Vision: Models, Learning, and Inference*, Simon J. D. Prince, First Edition, Cambridge University Press.
5. *Computer Graphics Through OpenGL*, SumantaGuha, Second Edition, CRC Press.
6. Gary Bradski& Adrian Kaehler, *Learning OpenCV: Computer Vision with the OpenCV Library*, O'Reilly Media.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**				
Course Name	**Reinforcement Learning**				
Type of Course	**DCC**				
Course Code	**MG7DCCADS402**				
Course Level	**400-499**				
Course Summary	This course introduces the fundamentals and algorithms of reinforcement learning, covering MDPs, dynamic programming, Monte Carlo methods, temporal-difference learning, and advanced policy optimization techniques.				
Semester	**VII**	Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	0	0	0	60
Pre-requisites, if any					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the foundational concepts of reinforcement learning, including agents, environments, MDPs, value functions, and optimal policies, to model and solve sequential decision-making problems.	U	1,2
2	Analyse basic reinforcement learning algorithms, including dynamic programming and Monte Carlo methods, for policy evaluation, improvement, and control in model-based and model-free environments.	An	2,4
3	Apply temporal difference learning and planning techniques, including TD(0), SARSA, Q-Learning, and Dyna, to improve policy learning in tabular reinforcement learning settings.	A	3,5
4	Understand policy gradient and actor-critic methods for reinforcement learning, including policy approximation, REINFORCE, and continuous action spaces, to optimize stochastic policies in complex environments.	U	1

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to RL and key concepts -agent, environment, state, action, reward, Elements of RL, Limitations and scope	5	1
	1.2	Finite Markov Decision Processes (MDP)-definition, Agent environment interface (Components of MDP) , goal and rewards, Markov property, Markov Decision Process, Value functions, Optimal value functions.	10	1
	1.3	Markov Decision Process, Value functions, Optimal value functions.	3	1
2	2.1	Basic Algorithms:- Dynamic Programming – Policy Evaluation, Policy Improvement, Policy Iteration, Valuation iteration, Efficiency of dynamic programming.	8	2
	2.2	Monte Carlo Methods- Prediction, Estimation of action values, MC Control without exploring starts, Off-Policy Prediction Via Importance Sampling, Off-Policy Monte Carlo Control.	8	2
3	3.1	Temporal Difference (TD) Learning –Prediction, Advantages of TD Prediction Methods, Optimality of TD (0),	6	3
	3.2	SARSA ,Q-Learning	2	3
	3.3	Planning and Learning with Tabular Methods-Models and planning, Dyna, Prioritized sweeping	5	3
4	4.1	Policy Gradient methods – Policy Approximation and its advantages., The Policy Gradient Theorem, REINFORCE- Monte Carlo-based policy gradient., REINFORCE with Baseline	8	4
	4.2	Actor Critic Methods, Policy Gradient for Continuing Problems ,Policy Parameterization for continuous actions	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks / Seminar / Viva/ Assignments** **Written Test**
	B. End Semester Evaluation **Written Test - 70 Marks - Duration 2 Hours**

	Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Reinforcement Learning: An Introduction by Sutton & Barto
2. Algorithms of Reinforcement Learning by Csaba Szepesvári
3. A Course in Reinforcement Learning (2nd Edition) by Dimitri P. Bertsekas
4. Fundamentals of Reinforcement Learning by Rafael Ris-Ala (2023)

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**				
Course Name	**Digital Marketing**				
Type of Course	**DCE**				
Course Code	**MG7DCEADS400**				
Course Level	**400 -499**				
Course Summary	This course provides a comprehensive overview of digital marketing, covering its evolution, core concepts, tools, platforms, and challenges, while also exploring e-banking, electronic payment systems, cyber security, SEO, social media, web analytics, and future enhancements.				
Semester	**VII**	Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		4	0	0	0
Pre-requisites, if any	Basic knowledge of marketing principles and familiarity with internet usage are helpful prerequisites for this course.				

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the nature, scope, and evolution of digital marketing.	U	1
2	Understand e-banking approaches, devices, services, and electronic payment systems, along with cyber security methods like encryption and firewalls.	A	2
3	Analyse the role of cyber security and electronic payment systems in the digital marketing environment.	An	3
4	Use digital tools like Google Analytics and Ad Words to measure and optimize marketing performance.	A	4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction: Nature, Scope and Importance of Digital Marketing; Evolution	3	1
	1.2	Digital Marketing; Core Concepts-Inbound Marketing, Content Marketing, Email Marketing, Influential Marketing; Holistic Digital Marketing Concept	3	1
	1.3	10Ps of digital marketing; Digital Marketing Environment: Macro and Micro Environment	4	1
2	2.1	E-banking: approaches, devices, services, benefits, drawbacks.	5	2
	2.2	Electronic payment systems-credit cards, debit cards, smart cards, credit accounts,	4	2
	2.3	cyber security, encryption, secret key cryptography, public key cryptography, digital signatures, firewalls	5	2
3	3.1	Digital Marketing: Search Engine Optimization (SEO), Social Media,	3	3
	3.2	Marketing; Email Marketing, Mobile Content Marketing. Challenges for Digital Marketing:	2	3
	3.3	Increased Security Risk, Cluttered Market, Less Focus on Keywords, More Ad Blockers, Increased Ad Costs	4	3
4	4.1	Digital Marketing: Pay per Click-Search Engine Advertising, Advantages, Factors, Conversion Rate Optimization (CRO); Digital Marketing- Web Analytic.	9	4
	4.2	Social Media Marketing: Face book, Pinterest, Twitter, LinkedIn, YouTube, Google Ad words, Google Analytics	9	4
	4.3	Issues and Future enhancement of Digital Marketing.	9	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks Written Test / Seminar / Viva/ Assignments**
	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Ian Dodson-The art of Digital Marketing, Wiley
2. Digital Marketing –Kamat and Kamat-Himalaya
3. Fundamentals of Digital Marketing, P.Singh Bhatia, Pearson
4. Puneet Singh Bhatia- Fundamentals of Digital Marketing, Pearson Education

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Technical Documentation**					
Type of Course	**DCE**					
Course Code	**MG7DCEADS401**					
Course Level	**400 – 499**					
Course Summary	This course introduces students to the principles and practices of technical documentation in computing and data science. It covers methods for preparing clear, structured, and professional documents such as reports, manuals, and project documentation. Students will gain skills in documentation standards, formatting, and effective communication for technical and research contexts.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0		60
Pre-requisites, if any	Students should have basic knowledge of computer systems, programming, and academic writing. Familiarity with word processing tools and presentation software is recommended.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the importance of technical documentation in computing and data science projects.	U	1
2	Apply documentation standards and tools to prepare structured reports and manuals.	A	2
3	Evaluate the clarity, accuracy, and effectiveness of technical documents.	E	3
4	Create professional documentation for projects, research, and presentations.	C	4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Technical Documentation: Definition and scope, Importance in computing projects, Role in communication.	5	1
	1.2	Types of Technical Documents: Reports and manuals, Proposals and project documentation, Research papers	5	1
	1.3	Documentation Standards: Formatting guidelines, Industry standards (IEEE, APA),Best practices	5	1
2	2.1	Word Processing Tools: MS Word basics, Latex for structured writing, Formatting features	5	2
	2.2	Document Design: Headings and subheadings, Tables and figures, References and citations	5	2
	2.3	Collaborative Documentation: Google Docs, Version control (Git),Cloud-based editing	5	2
3	3.1	Writing Style: Clarity and precision,Conciseness,Avoiding ambiguity	5	3
	3.2	Report Structure: Abstract and introduction, Methodology and results, Conclusion and references	5	3
	3.3	Referencing Styles: PA format, IEEE format, Citation management tools.	5	3
4	4.1	Project Documentation: User manuals, Technical specifications, System requirements	5	4
	4.2	Research Documentation: Thesis writing, Research reports, Case studies	5	4
	4.3	Presentation of Documents: Seminar preparation, Viva defence, Visual aids	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 30 Marks** **Written Test / Seminar / Viva/ Assignments**

	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks** **Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1.Sharon J. Gerson & Steven M. Gerson – Technical Writing: Process and Product, Pearson Education.
2.David Farkas & Jeanette Hanna – Technical Documentation: A Guide to Writing and Managing Content, Wiley.
3. IEEE Editorial Style Manual – IEEE Publications.
4.Joseph Heagney – Fundamentals of Project Management, AMACOM.
5.Michael Markel & Stuart A. Selber – Technical Communication, Bedford/St. Martin's.
6. William S. Pfeiffer – Technical Writing: A Practical Approach, Pearson.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Mobile Application Development – Android**					
Type of Course	**DCE**					
Course Code	**MG7DCEADS402**					
Course Level	**400 -499**					
Course Summary	This course introduces Android app development covering architecture, UI design, activities, multimedia, SQLite databases, telephony, JSON/XML, and Google services like maps and location.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	Basic knowledge of programming (preferably Java), object-oriented concepts, and fundamental computer skills.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand Android basics including architecture, versions, development tools, virtual machines, and layouts.	U	1
2	Design user interfaces using Android views, layouts, and controls.	A	3
3	Analyse Android components like activities, intents, services, multimedia, and SQLite database.	An	2
4	Develop Android applications with telephony, messaging, JSON/XML, and Google services.	C	3

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Android, Android Versions, Android Activity, Android Features and Architecture.	3	1
	1.2	Operating system, Java JDK, Android SDK, Android Development Tools, Android Virtual Devices.	3	1
	1.3	Emulators, Dalvik Virtual Machine, Difference between Java Virtual Machine (JVM) and Dalvik Virtual Machine (DVM), Layouts – Linear, Absolute, Frame, Relative and Table.	4	1
2	2.1	User interface with View- Text View, Buttons, Image Button, Edit Text, Check Box.	5	2
	2.2	Toggle Button, Radio Button and Radio Group, Progress Bar, Auto complete Text View, Spinner.	5	2
	2.3	List View, Grid View, Image View, Scroll View, Custom Toast Alert and Time and Date Picker.	5	2
3	3.1	Activity - Introduction, Intent, Intent _filter, Activity Life Cycle, Broadcast Life Cycle , Services.	4	3
	3.2	Multimedia-Android System Architecture, Play Audio and Video, Text to Speech.	4	3
	3.3	SQLite Database in Android- Introduction to SQLite Database, Creation and Connection of the Database, Extracting values from Cursors, Transactions.	7	3
4	4.1	Telephoning and Messaging-SMS Telephony, Sending SMS, Receiving SMS, Wi-Fi Activity.	6	4
	4.2	Introduction to JSON and XML, Use of JSON, Syntax and Rule of JSON,JSON Name , JSON Values, JSON Objects, JSON Arrays, Parsing JSON and XML.	8	4
	4.3	Google Play services, Location services, Maps.	6	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) - 30 Marks** **CCA for Theory: 30 Marks** **1. Written tests** **2. Assignments**
	B. End Semester Evaluation **<u>Written Test - 70 Marks - Duration 2 Hours</u>** **Part A - Short Answer Type Questions – 20 Marks(Answer any 10 questions out of 12) 10x2 = 20 Marks**

	Part B - Short Essay Type Questions – 30 Marks(Answer any 6 questions out of 8) 6x5 = 30 Marks **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks**

REFERENCES

1. Prasanna Kumar Dixit - ANDROID, Vikas Publishing House.
2. Anubhav Pradhan, Anil Deshpande, Composing Mobile Apps using Android, Wiley India Pvt.Ltd,2014.

SEMESTER VIII

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**				
Course Name	**Applied Optimization In Computing**				
Type of Course	**DCC**				
Course Code	**MG8DCCADS400**				
Course Level	**400-499**				
Course Summary	The objective of this course is to acquaint students with industrial problems and various methods for solving Linear Programming Problems, Transportation Problems, Assignment Problems, and their practical applications.				
Semester	**VIII**	**Credits**		**4**	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	**0**	**1**	**0**	**75**
Pre-requisites, if any	Basics of Operation Research.				

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Students will able to formulate and solve real-world optimization problems using Linear Programming techniques such as the Graphical Method, Simplex Method, and Big-M Method. Students will also develop the ability to analyse special cases and understand duality concepts for better decision-making in industrial applications.	U	1,2
2	To formulate transportation problems using matrix terminology and solve them through suitable optimization methods. They will also learn to find initial feasible solutions, derive optimal solutions, and address different practical variations of the transportation model	An	2,5
3	Learn to solve assignment problems using the Hungarian Method, including variations such as non-square matrices and maximization cases.	An	1,2

4	Apply R programming constructs to perform basic mathematical and matrix operations using vector and matrix representations, and utilize R as a computational tool for data analysis and mathematical modelling to analyse and solve computational problems.	A	1,2, 5
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Linear Programming: Introduction, Mathematical Formulation of LPP,	2	1
	1.2	Solution of LPP: Graphical Method, Exceptional Cases, The General LPP.	6	1
	1.3	Simplex Method: Definitions, Theory of Simplex Method, Artificial Variable Techniques: Big-M Method only	5	1
	1.4	Special Cases in Simplex Method, Application, Duality in Linear Programming	2	1
2	2.1	Transportation Problem: Introduction, Definitions of the Transportation Model, Matrix Terminology.	4	2
	2.2	Formulation and Solution of Transportation Model: Initial Feasible Solution and Optimal Solution.	6	2
	2.3	Variants in Transportation Problem	5	2
3	3.1	Assignment Problem: Definition of the Assignment Model, Mathematical Representation of Assignment Model, Comparison with the Transportation Problem.	4	3
	3.2	Solution of the Assignment Model. Hungarian Method for Solution of the Assignment Problems	7	3
	3.3	Formulation and Solution of the Assignment Model Variation of Assignment Problem: Non-square Matrix and Maximization Problem	4	3
4	4.1	Introduction to LaTeX interfaces, understanding Latex compilation, basic syntax	15	4
	4.2	Text Formatting, Writing equations, matrices, tables. Page Layout:	15	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**

Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks / Seminar / Viva/ Assignments** **Written Test** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1, Belly E Gillet-Introduction to Operations Research (A Computer Oriented Arithmetic Approach) (Tata Mc. Graw Hill).
2. V.K Kapoor-Operations Research.

SUGGESTED READINGS:

1. Kanti Swarup, P.K Gupta and Man Mohan - Operations Research, Sultan Chand &Sons.
2. K.V Mital and C. Mohan - Optimization Methods in Operations Research and System Analysis.
3. J. K Sharma-Operations Research Theory and Applications, Macmillan.
4. B. N. Mishra, B. K. Mishra – Optimization linear Programming Ane Books.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**				
Course Name	**Risk Assessment**				
Type of Course	**DCC**				
Course Code	**MG8DCCADS401**				
Course Level	**400-499**				
Course Summary	The **Risk Assessment course** provides students with a structured understanding of security threats, vulnerabilities, and countermeasures. It emphasizes prevention, detection, response, and management strategies to build secure information systems. By the end of the course, learners gain practical skills in risk identification, analysis, and mitigation, along with awareness of ethical practices in information security.				
Semester	**VIII**	Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	0	1	0	75
Pre-requisites, if any	Students should have a basic knowledge of computer networks, operating system fundamentals, and database management systems. In addition, introductory knowledge of cryptography and network security is required to understand the course content effectively.				

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand various security threats and vulnerabilities in computing infrastructures (wired, wireless, e-commerce, physical).	U	1
2	Analyse cryptographic methods, access control techniques, and biometric authentication to secure systems.	An	2
3	Evaluate the effectiveness of intrusion detection systems, antivirus solutions, and risk management tools.	E	3
4	Demonstrate awareness of security management policies, digital rights management, and ethical practices in information security.	A	4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Fundamentals Of Risk Assessment: Risk Assessment Overview: Role of security risk assessment, Definition of risk	3	1
	1.2	Need and Review of Risk Assessment: Need for security risk assessment, Risk assessment review	3	1
	1.3	Risk Assessment Models and Activities: Basic risk assessment, Gap assessment, Compliance audit, Security audit	4	1
	1.4	Vulnerability Scanning:, Identification of risks	3	1
2	2.1	Risk Identification And Analysis Information Security Risk Assessment Process: Project definition, Data gathering	5	2
	2.2	Threats and Vulnerabilities: Threats Vulnerabilities	4	2
	2.3	Risk Analysis: Risk analysis techniques, Risk identification	5	2
	2.4	Risk Reporting: Risk reporting, Documentation	4	2
3	3.1	Risk Management: Risk Mitigation: Methods to reduce or control risks, Types of controls: Administrative controls, Technical controls, Physical controls Implementation of appropriate controls to manage risks.	3	3
	3.2	Data Analysis: Methods of collecting relevant data for risk assessment, Proper handling and analysis of collected data,Use of data in decision-making for risk management.	2	3
	3.3	Risk Treatment Different approaches to handle risks: Risk reduction,Risk avoidance ,Risk transfer ,Risk acceptance Selecting suitable treatment methods based on risk level.	4	3
	3.4	Risk Monitoring: Continuous monitoring of identified risks, Reviewing and updating risk assessments regularly, Ensuring effectiveness of implemented controls. Continuous monitoring of identified risks. Reviewing and updating risk assessments regularly. Ensuring effectiveness of implemented controls.	5	3
4	4.1	Perform a network scan using Nmap and identify the open ports and services on a target system.	6	4
	4.2	Conduct a vulnerability assessment with OpenVAS and list one critical vulnerability found.	6	4
	4.3	Use Hydra to test password strength on an SSH login service with a wordlist.	6	4
	4.4	Configure Snort to detect a port scan and record the alerts generated.	6	4
	4.5	Capture network traffic using tcpdump and analyse the packets with Wireshark to identify suspicious activity.	6	4

5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks** **Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1. Mark Talabis, “Information Security Risk Assessment Toolkit: Practical Assessments through Data Collection and Data Analysis”, Syngress; 1 edition, ISBN: 978-1-59749-735-0, 2012. 27
2. David L. Cannon, “CISA Certified Information Systems Auditor Study Guide”, John Wiley & Sons, ISBN: 978-0-470-23152-4, 2009. MCF 4EA - ELECTIVE1

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**				
Course Name	**Block Chain**				
Type of Course	**DCE**				
Course Code	**MG8DCEADS400**				
Course Level	**400-499**				
Course Summary	Students will be able to understand the fundamentals of blockchain technology, including distributed systems, cryptographic primitives, Bitcoin architecture, decentralization methods, consensus algorithms, and will be able to implement blockchain components such as hash functions, a simple blockchain, Bitcoin transactions, and interact with the Bitcoin command-line interface.				
Semester	**VIII**	Credits		4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		3	0	1	0	75
Pre-requisites, if any	Basic understanding of computer networks, cryptography, and programming in Python.				

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the fundamentals of blockchain technology, including distributed systems, CAP theorem, and decentralization.	U	1
2	Explain cryptographic concepts used in blockchain, such as public/private key cryptography and hashing.	U	2
3	Analyse the structure and functioning of Bitcoin, including transactions, blocks, wallets, and consensus mechanisms.	An	3
4	Develop simple blockchain applications and simulate Bitcoin transactions using Python and CLI tools.	C	4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Block Chain Technology :Distributed systems- the history of block chain.	3	1
	1.2	Introduction to Block Chain- CAP theorem and blockchain	3	1
	1.3	Benefits and limitations of blockchain	4	1
	1.4	Decentralization using blockchain – methods of decentralization , Routes to decentralization	4	1
2	2.1	Cryptography in blockchain :- introduction, cryptographic primitives	5	2
	2.2	Asymmetric cryptographic- public key and private key	4	2
	2.3	Line Inference-Bitcoin Improvement proposal(BIPs), Consensus algorithm	5	2
3	3.1	BitCoin Introduction – transactions, structure-transaction types	3	3
	3.2	The structure of a block –the genesis block, the bitcoin network, wallet and its types	4	3
	3.3	Bitcoin payements-Bitcoin investment and buying and selling bitcoins	5	3
	3.4	Bitcoin installation-Bit coin programming and the command line interface , Bitcoin improvement proposal	5	3
4	4.1	Implement Cryptographic Hash Functions	10	4
	4.2	Build a Simple Blockchain in Python	10	4
	4.3	Simulate a Bitcoin Transaction, Interact with Bitcoin Using Command Line Interface (CLI).	10	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks** **Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks**

	Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **<u>Practical Examination 35 Marks – Duration 2 Hours</u>** **a. Demonstration** **b. Viva** **c. Record**

TEXT BOOKS:

1.Bashir, Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts
explained, 2nd Edition, 2nd Revised edition edition. Birmingham: Packt Publishing, 2018.

REFERENCE BOOKS:

1. M. Antonopoulos, Mastering bitcoin, First edition. SebastopolCA: O'Reilly,2015.
2. Z. Zheng, S. Xie, H. Dai, X. Chen, andH. Wang, ―An Overviewof Blockchain Technology: Architecture, Consensus, and Future Trends,‖ in 2017 IEEE International Congress on Big Data (BigData Congress), 2017, pp.557–564.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Natural Language Processing**					
Type of Course	**DCE**					
Course Code	**MG8DCEADS401**					
Course Level	**400-499**					
Course Summary	This course provides a comprehensive foundation for understanding and applying natural language processing techniques. It covers language fundamentals, linguistics resources, and advanced NLP topics, including part-of-speech tagging, parsing, semantics, word sense disambiguation, information retrieval, and practical applications like machine translation and automatic speech recognition.					
Semester	**VII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any						

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Describe the various levels of linguistic analysis.	U	2
2	Distinguish between various NLP techniques for managing and analyzing linguistic data.	U	1
3	Compare and contrast various aspects of natural language structure and analysis.	An	2
4	Understand core NLP techniques such as machine translation, information retrieval, text categorization, summarization, and speech processing.	A	2

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	H rs	CO No.
1	1.1	Introduction- Human languages, models, ambiguity, processing paradigms. Levels of language analysis- Syntax, Semantics, Pragmatics.	3	1
	1.2	Phonetics- Speech Sounds and Phonetic, Articulatory Phonetics, Prosody. Text representation in computers, encoding schemes.	2	1
	1.3	Linguistics resources- Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML	6	1
2	2.1	Management of linguistic data with the help of GATE, NLTK. Regular expressions, Finite State Automata, word recognition, lexicon.	5	2
	2.2	Morphology, acquisition models, Finite State Transducer. N-grams, smoothing, entropy, HMM, ME, SVM, CRF..	6	2
	2.3	Part of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions.	8	2
3	3.1	A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax	8	3
	3.2	Parsing-Unification, probabilistic parsing, TreeBank. SemanticsMeaning representation, semantic analysis, lexical semantics, WordNet.	4	3
	3.3	Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary-based approaches. DiscourseReference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure	3	3
4	4.1	**Program using python** 1.Write a program to calculate the total word count, unique word count, and frequency of each word in a given text file. 2.Implement a script to load a paragraph and filter out all English stop words using the NLTK library. 3.Write a program to load the Brown Corpus and display the first 10 sentences from the 'news' category. 4.Create a script that takes a word from the user and prints its synonyms and antonyms using WordNet. 5.Write a Python program using Regular Expressions to find all dates (MM/DD/YYYY) and website URLs in a document. 6.Compare the output of Word Tokenization and Sentence Tokenization on a paragraph containing abbreviations (e.g., "Dr. Smith went to the U.S.A.").	30	4

		7.Implement a script that processes a list of plural or past-tense words using both Porter Stemmer and WordNet Lemmatizer and display the results in a table. 8.Write a function to generate and display all Bigrams and Trigrams for a given sentence. 9.Load a sentence and apply Parts-of-Speech (POS) Tagging. Print each word along with its corresponding tag (NN, VB, JJ, etc.). 10.Use an NLP library to identify and categorize Named Entities (Persons, Organizations, Locations) from a short news article. 11.Write a program to demonstrate the use of a Finite State Transducer (FST) logic to find the root form of a word. 12.Implement a simple program to find the different meanings (senses) of a polysemous word (e.g., "fair" or "lead") based on the Lesk Algorithm. 13.Use a library or API to translate a simple sentence from English to Malayalam (or any other regional language). 14.Write a basic program to check if a user review is "Positive" or "Negative" by checking for the presence of specific keywords. 15.Implement a "Lead-3" summarizer that automatically extracts the first three important sentences of a long text document to create a summary.		
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks** **Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1. Speech and Language Processing,Daniel Jurafsky and James H Martin. 2e, PearsonEducation, 2009

2. Natural Language Understanding, James Allen, The Benjamin/Cummings Publishing Company Inc., Redwood City, CA. 2e,
3. Natural language processing and Informationretrieval, U. S. Tiwary and Tanveer Siddiqui.OUP, 2008

Mahatma Gandhi University Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Pattern Recognition**					
Type of Course	**DCE**					
Course Code	**MG8DCEADS402**					
Course Level	**400-499**					
Course Summary	Pattern recognition course provides a comprehensive exploration of fundamental concepts, including Bayesian Decision Theory, linear discriminant functions, and nonparametric techniques. Students will develop practical skills in applying these principles to real-world problems, mastering Bayesian parameter estimation, support vector machines, and stochastic/nonmetric methods for effective pattern recognition.					
Semester	**VIII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Must know programming, Basic Mathematics, fundamental knowledge of machine learning					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand Pattern Recognition Fundamentals and the principles of Bayesian Decision Theory.	U	2,3
2	Analyse Bayesian Parameter Estimation and Nonparametric techniques.	An	1,2, 3
3	Implement and analyze linear discriminant functions, support vector machines, multilayer neural networks, and various stochastic and nonmetric methods for classification and inference.	An	2,3

4	Implement Pattern Recognition techniques for solving Real World Problem.	A	3
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Pattern recognition systems: – The design cycle, Learning and Adaptation.	2	1
	1.2	Bayesian Decision theory: - two-category classification, Minimum error rate classification.	2	1
	1.3	Classifiers, Discriminant functions and Decision Surfaces, The normal density.	2	1
	1.4	Discriminant Functions for the Normal Density, Error probabilities and Integrals, Discrete Features, Missing and Noisy Features.	3	1
2	2.1	Bayesian Parameter estimation and Nonparametric Techniques:- Maximum likelihood estimation, Bayesian estimation,	3	2
	2.2	Bayesian Parameter Estimation: Gaussian case and general theory.	3	2
	2.3	Nonparametric techniques: – Density estimation, Parzen Windows,	3	2
	2.4	k-Nearest Neighbour Estimation, Nearest-Neighbour Rule, Fuzzy Classification.	4	2
3	3.1	Linear Discriminant Functions: - Linear discriminant functions and decision surfaces.	2	3
	3.2	Generalized linear discriminant functions, Two-category linearly separable case .Non-separable behaviour, Linear programming algorithms, Support vector machines.	4	3
	3.3	Multilayer neural networks – Feed forward operation and classification. Back propagation algorithm, Error surfaces, Back propagation as feature mapping	6	3
	3.4	Stochastic methods and Nonmetric methods: – Stochastic search, Boltzmann learning.	4	3
	3.5	Nonmetric methods: - Decision trees, CART, Other tree methods (ID3, C4.5) - Grammatical methods, Grammatical inference.	5	3
4	4.1	Load and Explore a Dataset	8	4
	4.2	Feature Extraction from Images	8	4
	4.3	Text Pre-processing	8	4

	4.4	Implement Supervised Classification	8	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	A. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1. "Pattern Classification", R.O.Duda, P.E.Hart and D.G.Stork, John Wiley,2nd Edition,2012.
2. "Statistical pattern Recognition", K. Fukunaga, Academic Press,2nd Edition 2013.
3. "Pattern Recognition: An Introduction", Devi V.S., Murty, M.N., Universities Press, Hyderabad, 2011
4. "Pattern Recognition", S.Theodoridis and K.Koutroumbas, Academic Press, 4th Edition, 2009.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**RESEARCH METHODOLOGY in AI & Data Science**					
Type of Course	**DCE**					
Course Code	**MG8DCEADS403**					
Course Level	**400 - 499**					
Course Summary	It provides students with the knowledge and skills required to conduct research effectively, choose appropriate research methodologies, and document research findings in a comprehensive dissertation					
Semester	**VIII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1	0	75
Pre-requisites, if any	Domain knowledge, Research aptitude.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the concepts of research and its significance in various disciplines	U	1
2	Evaluate research questions and hypotheses	E	1,2
3	Analyze appropriate research designs and methodologies for different types of studies	An	2,3

4	Apply various data collection methods, statistical and qualitative analysis techniques to interpret research data	A	2,3, 4,8
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Research Methodology: Meaning and Objectives of Research in AI & Data Science	5	1
	1.2	Types of Research (Fundamental, Applied, Descriptive, Analytical, Experimental)	5	1
	1.3	Research Process and Problem Formulation	5	1
2	2.1	Research Design and Data Collection: Features of a Good Research Design – Qualitative & Quantitative Approaches Sampling Design and Techniques in AI & Data Science Research	5	2
	2.2	Methods of Data Collection (Primary & Secondary Sources, Surveys, Experiments, Databases)	6	2
	2.3	Sampling Design and Techniques in AI & Data Science Research	5	2
3	3.1	Data Processing and Analysis Data Preparation (Editing, Coding, Classification, Tabulation)	5	3
	3.2	Use of AI & Data Science Tools (Python, R, Machine Learning Models for Research)	5	3
	3.3	Statistical Techniques and Analytical Tools (Descriptive & Inferential Analysis, Hypothesis Testing)	4	3
4	4.1	Interpretation and Report Writing: Interpretation of Research Results (Significance, Validity, Reliability)	10	4
	4.2	Ethical Considerations in AI & Data Science Research (Bias, Privacy, Transparency)	10	4
	4.3	Research Report Writing, Documentation, and Future Directions	10	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1. **Research Methodology: Methods and Techniques** – C.R. Kothari – Vishwa Prakashan, 2006
2. **Random Data: Analysis and Measurement Procedures** – Bendat, J.S. & Piersol, A.G. – Wiley Interscience, 2001
3. **Time Series Analysis and Its Applications** – Shumway, R.H. & Stoffer, D.S. – Springer, 2000
4. **Spectral Analysis and Its Applications** – Jenkins, G.M. & Watts, D.G. – Holden Day, 1986
5. **Fundamentals of Mathematical Statistics** – S.C. Gupta & V.K. Kapoor – Sultan Chand & Sons, 11th Edition, 2002
6. **Research Methods** – Donald H. McBurney – Thomson Learning, 5th Edition, 2006
7. **A Guide to LaTeX and Electronic Publishing** – Helmet Kopka & Patrick W. Daly – Addison-Wesley Longman Limited, 4th Edition, 2004
8. **MATLAB: An Introduction with Applications** – Amos Gilat – John Wiley & Sons, 2004
9. **LaTeX: A Document Preparation System** – Leslie Lamport – Addison Wesley, 1994

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Publication Ethics and Documentation**					
Type of Course	**DCE**					
Course Code	**MG8DCEADS404**					
Course Level	**400 - 499**					
Course Summary	It provides students with the knowledge and skills required to conduct research effectively, choose appropriate research methodologies, and document research findings in a comprehensive dissertation					
Semester	**VIII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1		75
Pre-requisites, if any	Domain knowledge, Research aptitude.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Understand the concepts of research and its significance in various disciplines	U	1
2	Evaluate research questions and hypotheses	E	1,2
3	Analyze appropriate research designs and methodologies for different types of studies	An	2,3
4	Apply various data collection methods, statistical and qualitative analysis techniques to interpret research data	A	2,3, 4,8

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	**Introduction to Research and Publication Ethics** Meaning, scope, and importance of research ethics	5	1
	1.2	Academic integrity and responsible conduct of research	6	1
	1.3	Unethical practices: plagiarism, falsification, fabrication	7	1
2	2.1	**Authorship and Ethical Practices in Research Authorship criteria and responsibilities**	6	2
	2.2	Conflicts of interest and peer review ethics	5	2
	2.3	Case studies of ethical violations in research	7	2
3	3.1	**Documentation and Referencing Standards** Principles of proper citation and referencing	6	3
	3.2	Documentation styles: APA, MLA, IEEE, Chicago, etc.	6	3
	3.3	Reference management tools (Mendeley, EndNote, Zotero)	7	3
4	4.1	**Tools, Policies, and Professional Standards** Plagiarism detection tools and their use (Turnitin, iThenticate, Grammarly)	7	4
	4.2	Open access publishing and copyright policies	6	4
	4.3	Ethical considerations in publishing AI and Data Science research	7	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecture and Practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks** **Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks**

	Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **<u>Practical Examination 35 Marks – Duration 2 Hours</u>** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES

1. **"Responsible Conduct of Research"** – Adil E. Shamoo & David B. Resnik, Oxford University Press.
2. **"Publication Ethics: A Philosophical Study"** – Peter Sandøe & Stig Andur Pedersen.
3. **"Ethics in Science: Ethical Misconduct in Scientific Research"** – John D'Angelo, CRC Press.
4. **"Research Methodology: Methods and Techniques"** – C.R. Kothari, New Age International Publishers.
5. **"The Chicago Manual of Style"** – University of Chicago Press.
6. **APA Publication Manual** – American Psychological Association.
7. **IEEE Editorial Style Manual** – IEEE.

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Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**					
Course Name	**Statistical Analysis of Research Data and Implementation Tools**					
Type of Course	**DCE**					
Course Code	**MG8DCEADS405**					
Course Level	**400 - 499**					
Course Summary	This course introduces statistical methods and tools for analyzing research data, covering descriptive, inferential, and computational approaches. It equips students with practical skills in data analysis using software tools, with applications in Artificial Intelligence and Data Science.					
Semester	**VIII**	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	1		75
Pre-requisites, if any	Basic knowledge of mathematics, probability, and programming fundamentals (Python/Excel) is recommended for understanding statistical analysis concepts.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcomes upon completion of this course, the students will be able to:	Learning Domains *	PO No
1	Explain statistical concepts, data types, and visualization techniques for research data.	U	1, 2
2	Apply descriptive and inferential statistics, including correlation, regression, and probability distributions, to real-world datasets.	A	2, 3
3	Perform hypothesis testing using parametric and non-parametric methods for decision making in AI & DS problems.	E	2, 4
4	Utilize statistical tools (Python, R, SPSS, Excel) for data reprocessing, analysis, and visualization with applications in AI & DS.	C	3, 4

Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)

COURSE CONTENT

Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Explain the role and importance of statistics in scientific research, Differentiate between types of data and measurement scales Apply statistical concepts in real-world AI & DS research problems.	8	1
	1.2	**Data Collection & Classification:** Identify and apply suitable methods of data collection. Demonstrate understanding of different sampling techniques. Organize and classify raw data for research analysis.	6	1
	1.3	**Data Presentation** Construct effective charts, tables, and graphs for data visualization, Interpret statistical plots to draw meaningful conclusions.	5	1
2	2.1	**Descriptive and Inferential Statistics:** calculate measures of central tendency and dispersion. Interpret skewness and kurtosis in datasets. Apply descriptive statistics for summarizing AI datasets.	8	2
	2.2	**Correlation and Regression:** Compute correlation coefficients and interpret relationships. Perform regression analysis and build predictive models. Apply regression and correlation techniques in AI/ML problems.	5	2
	2.3	**Probability and Distributions** Apply probability rules and theorems to research data. Use Binomial, Poisson, and Normal distributions for problem solving. Model uncertainty in AI systems using probability distributions.	6	2
3	3.1	**Estimation and Hypothesis Testing:** Formulate null and alternative hypotheses for research problems. Perform estimation using point and interval methods. Analyse statistical significance in AI & DS case studies.	8	3
	3.2	**Parametric Tests:** Apply Z-test, t-test, and F-test for data analysis. Perform ANOVA for comparing multiple groups, Evaluate AI models using hypothesis testing methods.	6	3
	3.3	**Non-Parametric Tests** Apply Chi-square test for independence and goodness-of-fit. Use Mann-Whitney U and Kruskal-Wallis tests for non-normal data. Justify the use of non-parametric methods in real-world research.	5	3
4	4.1	**Statistical Tools and Software:** Demonstrate use of Python, R, SPSS, and Excel for statistical analysis. Select appropriate tools for different types of research problems. Apply computational tools to analyse AI datasets effectively.	8	4
	4.2	**Research Data Analysis Process:** Pre-process and clean datasets for statistical analysis. Conduct exploratory data analysis (EDA) using visualization, Apply data analysis techniques in AI-related research projects.	5	4
5		Teacher Specific content.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** **Lecturer and practical**
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) 25 Marks** **Written Test / Seminar / Viva/ Assignments** **Practical 15 Marks**
	B. End Semester Evaluation **Written Test - 50 Marks - Duration 1 Hour 30 Minutes** **Part A - Short Answer Type Questions – 10 Marks(Answer any 10 questions out of 12) 10x1 = 10 Marks** **Part B - Short Essay Type Questions – 20 Marks(Answer any 4 questions out of 6) 4x5 = 20 Marks** **Part C - Essay Type Questions – 20 Marks(Answer any 2 questions out of 3) 2x10 = 20 Marks** **Practical Examination 35 Marks – Duration 2 Hours** **a. Demonstration** **b. Viva** **c. Record**

REFERENCES:

1. **Research Methodology: Methods and Techniques** – C.R. Kothari, New Age International Publishers, 2nd Edition, 2004.
2. **Fundamentals of Mathematical Statistics** – S.C. Gupta & V.K. Kapoor, Sultan Chand & Sons, 11th Edition, 2019.
3. **Probability and Statistics for Engineers and Scientists** – Ronald E. Walpole, Sharon L. Myers, Pearson Education, 9th Edition, 2018.
4. **Applied Multivariate Statistical Analysis** – Richard A. Johnson & Dean W. Wichern, Pearson, 6th Edition, 2013.
5. **Statistics for Data Science using Python** – Maurizio Petrelli, Springer, 2020.
6. **Practical Statistics for Data Scientists: 50 Essential Concepts** – Peter Bruce, Andrew Bruce & Peter Gedeck, O'Reilly Media, 2nd Edition, 2020.
7. **Using SPSS for Windows and Macintosh: Analyzing and Understanding Data** – Samuel B. Green & Neil J. Salkind, Pearson, 7th Edition, 2016.

Mahatma Gandhi University
Kottayam

Programme	**BSc (Hons) ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**				
Course Name	**PROJECT/DISSERTATION**				
Type of Course	**PRJ**				
Course Code	**MG8PRJADS400**				
Course Level	**400 - 499**				
Course Summary	The aim of the project is to test the independent research skills students have acquired during their time at University/College.				
Semester	**VIII**	Credits		12	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others
		0	0	12	
Pre-requisites, if any					

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Practical
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA) 60 Marks**
	End Semester Evaluation 140 Marks

Internship Guidelines for Graduates

Introduction:

An internship is a valuable opportunity for recent graduates to gain hands-on experience, develop professional skills, and explore potential career paths. However, navigating the internship search and maximizing its benefits can require some guidance. Here are some key internship guidelines to help you succeed:

Preparation:

- **Define your goals:** Reflect on what you want to achieve through an internship. This will help you target your search towards relevant fields and opportunities.
- **Research and identify opportunities:** Explore potential career paths, research companies that align with your interests, and utilize resources like university career centres, online job boards, and professional networks.
- **Craft strong application materials:** Tailor your resume and cover letter to each specific internship, highlighting relevant skills and experiences.
- **Prepare for interviews:** Practice answering common interview questions, research the company and the internship position, and prepare to ask insightful questions yourself.

During the internship:

- **Professionalism:** Arrive on time, dress appropriately, maintain a positive attitude, and demonstrate professionalism and responsibility in all interactions.
- **Initiative and proactiveness:** Take initiative, ask questions, volunteer for new tasks, and show a willingness to learn and contribute.
- **Building relationships:** Network with colleagues, supervisors, and mentors. Cultivate positive relationships and seek guidance when needed.
- **Effective performance:** Meet deadlines, complete assigned tasks to the best of your ability, take ownership of your work, and be open to constructive feedback.
- **Learning and growth:** Track your progress, record new skills learned, and actively seek opportunities to expand your knowledge and experience.

Additional Tips:

- **Communication:** Practice effective communication skills, both written and verbal, ensuring clarity, professionalism, and respect in all interactions.
- **Adaptability:** Be flexible and adaptable to a changing work environment and new challenges.
- **Ethics:** Maintain ethical conduct, upholding the company's values and principles.
- **Reflection:** Regularly reflect on your experience, identify areas for improvement, and connect your learnings to your career goals.

Remember:

- An internship is a learning experience, so don't be afraid to ask questions, make mistakes, and learn from them.

- Be proactive in seeking out new challenges and opportunities to expand your skillset and demonstrate your value.
  Make a positive impression and build strong relationships, as these connections can be valuable assets in your future career.

Project Guidelines for Graduates

This major project shall be presented in several chapters, starting with an introduction and ending with a summary and conclusions. Each of the other chapters will have a precise title reflecting the contents of the chapter. A chapter can be subdivided into sections, subsections, and subsubsection to present the content discretely and with due emphasis.

Project Overview:

Briefly describe the purpose of the project and how it aligns with the course learning objectives.

Project Requirements:

- **Topic Selection:**
  - Outline the procedures for selecting a project topic, including any limitations or specific requirements for topic selection.
  - Mention any resources available to support students in their topic selection process.
- **Project Proposal:**
  - Specify the format and content requirements for the project proposal, such as research question, methodology, and expected outcomes.
  - Mention the due date for submission and the review process.
- **Deliverables:**
  - Clearly outline the expected deliverables of the project, such as a final report, presentation, or prototype.
  - Specify the format, length, and submission deadlines for each deliverable.
- **Collaboration:**
  - Clearly state the policies regarding collaboration between students, if permitted.
  - If collaboration is allowed, define expectations for individual contributions and team dynamics.
- **Ethical Considerations:**
  - Emphasize the importance of adhering to ethical research practices, including data privacy, plagiarism avoidance, and proper citation methods.
  - You may also want to mention any specific ethical considerations relevant to the project topics or research methodologies.

Major Project must be organized in the following order.

- Cover page
- Inside Title Page
- Project completion certificate from the industry/organization.
- Certificate signed by the Supervisor(s) (in the stipulated format)
- Declaration signed by the Candidate (in the stipulated format)
- Acknowledgments

- List of research publication related to project in IEEE format (if any)
- Abstract
- Table of Contents
- List of Figures
- List of Tables
- Abbreviations/Notation/Nomenclature (if any)

Chapter 1. Project Description

1.1 Project Overview
1.2 The Purpose of the Project
1.3 The Scope of the Work
1.4 Product Scenarios
1.5 Stakeholders
1.6 Mandated Constraints
1.7 Naming Conventions and Definitions
1.8 Relevant Facts and Assumptions

Chapter 2. Requirements

2.1 Product Use Cases
2.2 Functional Requirements
2.3 Data Requirements
2.4 Performance Requirements
2.5 Maintainability and Supportability Requirements
2.6 Security Requirements
2.7 Usability and Humanity Requirements
2.8 Look and Feel Requirements
2.9 Operational and Environmental Requirements
2.10 Cultural and Political Requirements
2.11 Legal Requirements

Chapter 3. Design

3.1 System Design
3.2 Current Software Architecture
3.3 Proposed Software Architecture
3.4 Subsystem services
3.5 User Interface
3.6 Object Design

Chapter 4. Test Plans

Content here……

Chapter 5. Project Issues

Content here…

Chapter 6. References/Bibliography

- Appendix (if any) xv
- Code of programs used in major project experiment(s) (in standard format with proper descriptions)
- Non-paper materials (if any)

MAJOR PROJECT FORMAT

1.1. Paper

- **Quality:** The project shall be printed on white bond paper, whiteness 95% or above, weight 75 gram or more per square meter.
- **Size:** The size of the paper shall be standard A 4; height 297 mm, width 210 mm.
- **Typesetting:** The standard font shall be Times New Roman of 12 pts with 1.5 line spacing
- **Page format:** The Printed Sheets shall have the following written area and margins:

Top Margin	15 mm
Head Height	3 mm
Head Separation	12 mm
Bottom Margin	22 mm
Footer	3 mm
Foot Separation	10 mm
Text Height	245 mm
Text Width	160 mm

When the header is not used the top margin shall be 30 mm.

- Left and Right Margins

The candidates shall have the options of single or double -sided printing

- Single-sided/odd number page (in double-sidedprinting) Left Margin 30mm Right Margin 20 mm
- Double sided- even-numbered page Left Margin 20mm Right Margin 30mm

- **Pagination:** Page numbering in the text of the project shall be Hindu-Arabic numerals at the center of the footer. But when the candidate opts for header style the page number shall appear at the right and left top corner for the odd and even number pages, respectively. Page number "1" for the first page of the Introduction chapter shall not appear in print, only the second page will bear the number "2". The subsequent chapters shall begin on a fresh page (fresh odd number page in case of double-sided printing). When header style is chosen the first page of each chapter will not have the header and the page number shall be printed at the center of the footer. Pagination for pages before the Introduction chapter shall be in lower case Roman numerals, e.g., "iv".

- **Header:** When the header style is chosen, the header can have the Chapter number and Section number (e.g., Chapter 2, Section 3) on even-numbered page headers and the Chapter title or Section title on the odd-numbered page header.
- **Paragraph format:** Vertical space between paragraphs shall be about 2.5 line spacing. The first line of each paragraph should normally be indented by five characters or 12mm. A candidate may, however, choose not to indent if (s) he has provided sufficient paragraph separation.
  A paragraph should normally comprise more than one line. A single line of a paragraph shall not be left at the top or bottom of a page (that is, no windows or orphans should be left). The word at the right end of the first line of a page or paragraph should, as far as possible, not be hyphenated.

- **CHAPTER AND SECTION FORMAT**

1.1 Chapter: Each chapter shall begin on a fresh page (odd number page in case of double-sided printing) with an additional top margin of about 75mm. Chapter number and title shall be printed at the center of the line in 6mm font size (18pt) inboldface using both upper and lower case (all capitals or small capitals shall not be used). A vertical gap of about 25mm shall be left between the Chapter number and Chapter title lines and between the chapter title line and the first paragraph.

1.2 Section and Sub-sections: A chapter can be divided into Sections, Sub-sections, and Sub-Section to present different concepts separately. Sections and sub-sections can be numbered using decimal points, e.g., 2.2 for the second section in Chapter 2 and 2.3.4 for the fourth Sub-section in the third Section of Chapter 2. Chapters, Sections, and Sub-sections shall be included in the contents with page numbers flushed to the right. Further subsections need not be numbered or included in the contents.
The Section and Sub-Section titles along with their numbers in 5 and 4mm (16 and 14 pt) fonts, respectively, in boldface shall be flushed to the left (not centered) with 15 mm space above and below these lines.

In further subdivisions character sizes of 3 and 3.5 with a bold face, small caps, all caps, and italics may be used for the titles flushed left or centered. These shall not feature in the contents.

1.3 Table/figure format: As far as possible tables and figures should be presented in portrait style. Small size tables and figures (less than half of the writing area of a page) should be incorporated within the text, while larger ones may be presented on separate pages. Table and figures shall be numbered chapter -wise. For example, the fourth figure in chapter 5 will bear the number Figure 5.4 or Fig 5.4
Table number and title will be placed above the table while the figure number and caption will be located below the figure. Reference for Table and Figures reproduced from elsewhere shall be cited in the last and separate line in the table and figure caption, e.g. (after McGregor [12]).

AUXILIARY FORMAT

- **Binding:** The evaluation copies of the major project may be spiral-bound or soft bound. The final hardbound copies to be submitted after the viva-voce examination will be accepted during the submission of a major project with the following color specification:

- **FRONT COVERS:** The front covers shall contain the following details:
  - The full title of the major project in 6 mm 22 point's size font is properly cantered and positioned at the top.
  - Full name of the candidate in 4.5 mm 15 point's size font properly cantered at the middle of the page.
  - A 40 mm Charkha replica of the University emblem followed by the name of the department, name of the University, and the year of submission, each in a separate line and properly cantered and located at the bottom of t h e page.
- **LETTERING:** All lettering shall be embossed or printed in gold
- **BOUND BACK**: The degree, the name of the candidate, and the year of submission shall also be embossed on the bound (side) in gold.
- **BLANK SHEETS**: In addition to the white sheets (binding requirement) two white sheets shall be put at the beginning and the end of the project.
- **TITLE SHEET:** This shall be the first printed page of the project and shall contain the submission statement: the major project submitted in partial fulfillment of the requirements of the Degree, the name and Roll No. of the candidate, name(s) of the Supervisor and Co-Supervisor (s) (if any), Department, Institute and year of submission.

- **ABSTRACT:** The approx. 500-word abstract shall highlight the important features of the major project and shall correspond to the electronic version to be submitted to the Library for inclusion on the website. The Abstract in the major project, however, shall have two more parts, namely, the layout of the major project giving a brief chapter- wise description of the work and the keywords.

- **TABLE OF CONTENTS:** The contents shall follow the Abstract and shall enlist the titles of the chapters, section and sub-section using decimal notation, as in the text, with corresponding page number against them, flushed to the right.

- **LIST OF FIGURES:** Two separate lists of Figure captions and Table titles along with their numbers and corresponding page numbers against them shall follow the Contents.

- **LIST OF TABLES**

- **DECLARATION:** A declaration of Academic honesty and integrity is required to be included along with every major project .

- **B. PROJECT SUBMISSION GUIDELINES**

To have the project examined, the number of project copies to be submitted to the Head of the Department should correspond to the number of examiners (including project supervisors) for a degree student.

Evaluation Criteria:

- List the specific criteria on which the project will be evaluated, such as:

- **Clarity and focus of the project topic and research question**
- **Depth and quality of research**
- **Effectiveness of the chosen methodology**
- **Critical analysis and interpretation of results**
- **Quality and organization of project deliverables (report, presentation, etc.)**
- **Adherence to ethical guidelines and proper citation methods**
- **Professionalism in communication and presentation**

Additional Resources:

- List any resources available to students to support their project work, such as:
  - Library resources (databases, journals, books)
  - Writing centre services
  - Software or technology specific to the project topic
  - Consultation hours with the instructor or teaching assistants