Mahatma Gandhi University
Kottayam

Programme	**BCA (Honours)**					
Course Name	**Artificial Intelligence**					
Type of Course	**Core Course**					
Course Code	**MG4CCRBCA200**					
Course Level	**NA**					
Course Summary	The course introduces the fundamental concepts of Artificial Intelligence (AI). It covers AI problem-solving search techniques, including both uninformed and informed search methods. The role of logic and reasoning in AI is explored, along with essential inference techniques. Various domains and applications of AI are examined, such as Machine Learning, Computer Vision, Robotics, Natural Language Processing, and Deep Neural Networks. The course also examines the architecture and role of expert systems through case studies. Additionally, it addresses the legal and ethical issues related to AI, discussing privacy, bias, and societal impacts.					
Semester	4	Credits			5	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	1	0	90
Pre-requisites, if any	Basic understanding of computer science concepts, including data structures and algorithms. Proficiency in any one programming language, such as Python.					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the characteristics of rational agents and gain insights about problem-solving agents.	An	1,2
2	Analyse Uninformed and informed search techniques.	An	1, 2

3	Apply knowledge representation using Propositional logic and Predicate calculus for inference/reasoning and handling uncertainty through probabilistic reasoning and fuzzy sets	An	1, 2, 3
4	Illustrate AI domains and their applications and examine the legal and ethical issues of AI	An	2
5	Apply search strategies, solve constraint-based problems, build rule-based systems, evaluate optimization methods, and use basic NLP techniques in intelligent systems.	E	1, 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 transactions (Units)

Module	Units	Course description	Hrs	CO No.
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
	2	Knowledge-Based Agents: Introduction to Knowledge-Based Agents, The Wumpus World as an Example World.	5	1
	3	Problem-solving: Problem-solving agents	5	1
2	1	Advanced Search Techniques Uninformed Search: DFS, BFS.	3	2
	2	Informed Search: Best First Search, A* search, AO* search.	4	2
	3	Constraints and Constraint Satisfaction Problems (CSPs), Backtracking search for CSP. Adversarial Search & Games: Two-player zero-sum games, Minimax Search, Alpha-Beta pruning.	4	2
	4	Evolutionary Search Techniques: Introduction to evolutionary algorithms, Genetic algorithms, Applications of evolutionary search in AI.	4	2
	1	Logical Reasoning and Uncertainty Logic: Propositional logic, First-order predicate logic, Propositional versus first-order inference, Unification and lifting.	5	3

3	2	First Order Inference: Forward chaining, Backward chaining, Resolution, Truth maintenance systems.	5	3
	3	Handling Uncertainties:, Probabilistic reasoning, Introduction to Fuzzy set theory	5	3
4	1	Domains and Applications of AI: Introduction to Machine Learning, Computer Vision, Robotics, Natural Language Processing, Neural Networks.	6	4
	2	Expert Systems: The architecture and role of expert systems (include two case studies).	6	4
	3	Legal and Ethical Issues: Concerns related to AI	3	4
	Case Studies of each module of the syllabus, providing real-world relevance and practical insights		30	5

5	Group – 1	**Case Study 1**: **AI in Customer Service (Intelligent Agents)** • **Scenario**: A leading e-commerce platform implements AI-powered chatbots to handle customer queries efficiently. • **Details**: Discuss how intelligent agents operate in dynamic environments, adapt to user inputs, and learn over time. Focus on concepts like rationality, agent structure, and agent-environment interaction. **Case Study 2**: **The Wumpus World** • **Scenario**: The classic Wumpus World problem illustrates knowledge-based agents navigating an environment with uncertainty. • **Details**: Extend the problem to real-world examples, such as robot navigation in unknown terrains or automated cleaning robots in dynamic home environments. **Case Study 3**: **Google Maps and Navigation Systems (Search Techniques)** • **Scenario**: Explore how Google Maps uses A* search for route optimization and heuristic-based problem-solving. • **Details**: Discuss the trade-offs between uninformed (DFS, BFS) and informed searches like A*, and their real-world implications for user experience. **Case Study 4**: **Chess and Adversarial Search** • **Scenario**: AI systems like Deep Blue playing chess against world champions. • **Details**: Analyze how the Minimax algorithm and Alpha-Beta pruning were used to evaluate game states, optimize moves, and win against human players.

	Group - 2	**Case Study 1: Solving the 4-Queens Problem** • **Objective**: Demonstrate CSP techniques like backtracking and constraint propagation. • **Scenario**: The 4-Queens Problem requires placing four queens on a chessboard such that no two queens threaten each other. • **Details**: Formulate the problem as a CSP where variables represent columns, and domains represent rows. Use backtracking to place queens, ensuring constraints (no same row, column, or diagonal placement) are satisfied. Explore improvements with forward checking and arc consistency. **Case Study 2: Solving a Sudoku Puzzle** • **Objective**: Apply constraint propagation and backtracking to a classic problem. • **Scenario**: A partially filled Sudoku grid must be completed so that each row, column, and subgrid contains unique digits. • **Details**: Represent rows, columns, and grids as variables. Apply initial constraint propagation to reduce possible values for each cell. Use backtracking to fill cells while maintaining consistency. **Case Study 3: Scheduling Problem (Timetable Generation)** • **Objective**: Analyze constraints and use CSP techniques for optimization. • **Scenario**: A university needs to generate a timetable for courses, ensuring no instructor or student group has overlapping schedules. • **Details**: Variables: Time slots for courses. Domains: Available time slots. Constraints: Instructors and classrooms must not overlap, and prerequisites must be scheduled in sequence. Use constraint propagation to eliminate invalid slots and backtracking to finalize the schedule. **Case Study 4: Cryptarithmetic Problem**

		• **Objective**: Solve a CSP involving digits and arithmetic operations. • **Scenario**: Solve a problem like SEND + MORE = MONEY, where each letter represents a unique digit. • **Details**: Variables: Letters (S, E, N, D, M, O, R, Y). Domains: Digits 0-9. Constraints: Each letter must have a unique digit, and the arithmetic sum must be valid. Apply constraint propagation and backtracking to identify valid digit assignments. **Case Study 5: Resource Allocation for a Project** • **Objective**: Optimize resource allocation using CSP techniques. • **Scenario**: Assign tasks to team members while ensuring deadlines are met and workloads are balanced. • **Details**: Variables: Tasks. Domains: Available team members. Constraints: Skillset match, task dependencies, and workload distribution. Use constraint propagation to filter infeasible assignments and backtracking for optimal allocation.
	Group - 3	**Case Study 1**: **Expert Systems for Medical Diagnosis** • **Scenario**: Implementation of an expert system for diagnosing diseases based on patient symptoms and history. • **Details**: Discuss the use of propositional logic and first-order predicate logic in building rule-based systems for accurate diagnosis. **Case Study 2**: **Handling Uncertainty in Weather Forecasting** • **Scenario**: Probabilistic reasoning and Bayesian networks used in weather prediction systems. • **Details**: Explore how these systems manage incomplete or uncertain data to provide accurate forecasts.

	Group - 4	**Case Study 1: Loan Approval System** • **Objective**: Design a rule-based system for automating loan approval processes in banks. • **Scenario**: A system evaluates loan applications based on predefined criteria like credit score, income, and existing debt. • **Details**: **Knowledge Base**: Rules like IF credit_score > 700 AND income > 50000 THEN approve_loan. **Inference Mechanism**: Backward chaining to verify whether a specific loan can be approved, tracing required conditions. **Outcome**: Faster decision-making and reduced manual intervention in loan processing. **Case Study 2: Smart Home Automation** • **Objective**: Implement a rule-based system for automating home appliances. • **Scenario**: A smart home system adjusts lighting, temperature, and security based on user preferences and external conditions. • **Details**: **Knowledge Base**: Rules like IF time = night AND motion_detected = true THEN turn on the lights. **Inference Mechanism**: Forward chaining to trigger actions based on sensor inputs. **Outcome**: Enhanced user convenience and energy efficiency. **Case Study 3: Rule-Based Chatbot** • **Objective**: Create a chatbot for answering customer queries using predefined rules. • **Scenario**: A rule-based chatbot helps users with common issues like order tracking or account settings. • **Details**: **Knowledge Base**: Rules like IF user_query = "Where is my order?" THEN respond = "Please provide your order ID." **Inference Mechanism**: Forward chaining to determine the appropriate response based on input queries. **Outcome**: Seamless user interaction and improved customer support.

	Group - 5	**Case Study 1**: **AI in Autonomous Vehicles** • **Scenario**: Self-driving cars developed by companies like Tesla and Waymo. • **Details**: Discuss the integration of computer vision, machine learning, and robotics to enable vehicles to navigate safely. **Case Study 2**: **AI in Natural Language Processing (NLP)** • **Scenario**: Language translation systems like Google Translate or voice assistants like Alexa. • **Details**: Examine the challenges of context understanding, ambiguity resolution, and real-time processing in NLP. **Case Study 3**: **Legal and Ethical Issues in AI** • **Scenario**: Controversy around AI bias in hiring systems and facial recognition technologies. **Details**: Discuss ethical considerations, data privacy issues, and the importance of fairness and accountability in AI systems.
Students must prepare a report based on at least one case study analysis from each group of Module 5.		

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Use of ICT tools in conjunction with traditional classroom teaching methods • Interactive sessions • Class discussions • Practical sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA for Theory : 30 Marks** • Written Exam • Oral Presentations • Assignments **CCA for Practical : 15 Marks** • Evaluation of Case Study Assignments/report based on Module 5 • Report must include at least one case study from each of the five groups.
	B. End Semester Examination **ESE for Theory: Written test (70 Marks, 2 Hours)** Part A: Very Short Answer Questions (Answer all) - (5*2=10 Marks)

	Part B: Short answer Questions (5 out of 7 Questions) - (5*6=30 Marks) Part C: Essay Questions (2 out of 3 Questions) - (2*15=30 Marks) **ESE for Practical Component: 35 Marks** Lab Record : 15 Marks Viva : 20 Marks • Viva Voce based on the submitted report. • No Practical Examination.

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

Suggested Reading:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence" Second Edition, Tata McGraw-Hill Edition.
2. Nilsson Nils J, Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.
3. Rajiv Chopra, Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Khanna Book Publishing Company, 2024.
4. M.C. Trivedi, Introduction to AI and Machine Learning, Khanna Book Publishing Company, 2024.
5. Van Hirtum, A. & Kolski, C. (2020). Constraint Satisfaction Problems: Algorithms and Applications. Springer
6. Rajiv Chopra, Machine Learning and Machine Intelligence, Khanna Book Publishing Company, 2024

Mahatma Gandhi University
Kottayam

Programme	**BCA (Honours)**					
Course Name	**Entrepreneurship and Startup Ecosystem**					
Type of Course	**VAC**					
Course Code	**MG4VACBCA200**					
Course Level	**NA**					
Course Summary	This course provides a comprehensive introduction to Design Thinking, a human-centered approach to innovation that integrates the needs of people, the possibilities of technology, and the requirements for business success. Students will explore creative thinking processes, problem-solving approaches, and the importance of customer-centricity in the modern business landscape.					
Semester	4	Credits			2	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	0	0	30
Pre-requisites, if any	Nil					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Understand the legacy of family businesses and key differentiations from entrepreneurship. Be able to identify a business opportunity and translate it into a viable business model.	An	1,3
2	Understand the basic building blocks of creating a venture. Identify the elements of the Indian entrepreneurship ecosystem and leverage the relevant benefits from its constituents.	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 transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Introduction to Entrepreneurship & Family Business : Definition and Concept of entrepreneurship, Entrepreneur Characteristics, Classification of Entrepreneurs,	2	1
	1.2	Role of Entrepreneurship in Economic Development –Start-ups,	2	1
	1.3	Knowing the characteristics of Family business with discussion on few Indian cases of Family Business like Murugappa, Dabur, Wadia, Godrej, Kirloskar etc.	3	1
	1.4	Evaluating Business opportunity: Sources of business ideas and opportunity recognition, Guesstimating the market potential of a business idea,	4	1
	1.5	Feasibility analysis of the idea, Industry, competition and environment analysis.	4	1
2	2.1	Building Blocks of starting ventures, Low cost Marketing using digital technologies,	2	2
	2.2	Team building from scratch, Venture Funding, Establishing the value-chain and managing operations,	3	2
	2.3	Legal aspects like IPR and compliances.	2	2
	2.4	Start-up Ecosystem: Know the components of the start-up ecosystem including Incubators, Accelerators, Venture Capital Funds, Angel Investors etc.,	4	2
	2.5	Know various govt. schemes like Start-up India, Digital India, MSME etc., Sources of Venture Funding available in India, Source of Technology, Intellectual Property management.	4	2

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Use of ICT tools in conjunction with traditional classroom teaching methods • Interactive sessions

	• Class discussions
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **CCA for Theory : 15 Marks** • Oral Presentations • Assignments • Written Exam
	B. End Semester Examination **ESE for Theory: 35 Marks (1 Hour)** Part A: Very Short Answer Questions (5 out of 7 Questions) - (5*3=15 Marks) Part B: Short Answer Questions (4 out of 6 Questions) - (4*5=20 Marks)

REFERENCES:

1. Startup India Learning Program by Start Up India available at www.startupindia.gov.in
2. Entrepreneurship, Rajeev Roy, Oxford University Press
3. Entrepreneurship: Successfully Launching New Ventures by R. Duane Ireland Bruce R. Barringer, Pearson Publishing
4. Family Business Management by Rajiv Agarwal, Sage Publishing Anish Tiwari (2003), "Mapping the Startup Ecosystem in India", Economic & Political Weekly
5. Ramachandran, K, Indian Family Businesses: Their survival beyond three generations, ISB Working Paper Series

	Mahatma Gandhi University **Kottayam**
Programme	**BCA (Honours)**
Course Name	**IT and Environmental Sustainability**
Type of Course	**VAC**
Course Code	**MG4VACBCA201**
Course Level	NA
Course Summary	This course aims to familiarize students with fundamental environmental concepts and their relevance to IT and business operations, preparing them to address forthcoming sustainability challenges. It is designed to equip students with the knowledge and skills needed to make decisions that account for environmental consequences, fostering environmentally sensitive and responsible future managers.

Semester	4	Credits			2	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	0	0	30
Pre-requisites, if any	NIL					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Describe the components of the environment, natural resources, and ecosystems, and explain sustainable practices for their conservation.	U	1,3
2	Identify types of pollution and waste, explain sustainable development goals, and summarize key environmental laws and their impact on society and businesses.	An	1,3, 6
3	Explain key social issues, environmental laws, and the role of population dynamics in promoting sustainable development.	An	1,6, 7,8

**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	**Understanding Environment, Natural Resources, and Sustainability**:			
	1.1	Components and segments of the environment, the man-environment relationship, Concept of sustainability; Classification of natural resources, issues related to their overutilization, and strategies for their conservation.	2	1
	1.2	sustainable practices in managing resources, including deforestation, water conservation, energy security, and food security issues. importance of public awareness and education.	3	1
	Ecosystems, Biodiversity, and Sustainable Practices:			
	1.3	Various natural ecosystems, learning about their structure, functions, and ecological characteristics.	2	1
	1.4	The importance of biodiversity, the threats it faces, and the methods used for its conservation.	2	1
	1.5	Need for sustainable ecosystem management, Significance of India as a mega diverse nation.	2	1
2	**Environmental Pollution, Waste Management, and Sustainable Development:**			
	2.1	Various types of environmental pollution, including air, water, noise, soil, marine pollution, E-waste, and their impacts on businesses and communities. Causes of pollution, such as global climate change, ozone layer depletion, the greenhouse effect, and acid rain, with a particular focus on pollution episodes in India.	2	2
	2.2	Classification of waste: solid, liquid, hazardous, and electronic waste. Principles of waste management: 3Rs – Reduce, Reuse, Recycle.	2	2
	2.3	Methods of waste disposal: landfilling, composting, incineration, recycling. E-waste management: Challenges and best practices. Role of IT in efficient waste management (smart bins, waste tracking apps).	3	2
	2.4	Concept and need for sustainability. Principles of sustainable development: Economic growth, Environmental protection, Social inclusion.	2	2
	2.5	UN Sustainable Development Goals (SDGs) with a focus on environmental goals. Green technologies and innovations: Renewable	2	2

		energy, Green computing, Eco-friendly products. Role of individuals and technology professionals in promoting sustainability.		
3	**Social Issues and Legislation:**			
	3.1	Dynamic interactions between society and the environment, with a focus on sustainable development and environmental ethics.	3	3
	3.2	Overview of key environmental legislation and the judiciary's role in environmental protection, including the Water (Prevention and Control of Pollution) Act of 1974, the Environment (Protection) Act of 1986, and the Air (Prevention and Control of Pollution) Act of 1981.	2	3
	3.3	Environmental justice, environmental refugees, and the resettlement and rehabilitation of affected populations; Ecological economics, human population growth, and demographic changes in India.	3	3

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** Lectures, Discussions, Case Analysis
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA for Theory: 15 Marks** • Written test • Assignments • MCQ
	B. End Semester Examination (ESE) **ESE for Theory: Written Test (35 Marks, 1 Hr)** Part A: Short Answer Questions (7 out of 10 Questions) - (7*5=35 Marks)

REFERENCES:

1. Text Book of Environmental Studies by Bharucha, E., 3rd Edition, Orient Blackswan Private Ltd.
2. Environmental Studies, 3rd ed., Poonia, M.P. Khanna Book Publishing Co.
3. Sustainable Development: Environment, Energy and Water Resources. Roy, M. G., Ane Books.
4. Fundamentals of environmental studies, Basu, M., & Xavier Savarimuthu, S. J., Cambridge University Press.
5. Text Book of Environmental Studies, Dave, D., & Katewa, S. S Cengage Learning India Pvt Ltd.

6. Rajagopalan, R. *Environmental studies: from crisis to cure* (4th ed.). Oxford University Press.

SUGGESTED READINGS:

Web links:

- https://www.ourplanet.com
- https://www.undp.org/content/undp/en/home/sustainable-development-goals.html
- www.myfootprint.org
- https://www.globalchange.umich.edu/globalchange1/current/lectures/kling/ecosystem/ecosystem.html

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Programme	**BCA (Honours)**					
Course Name	**Object Oriented Programming using Java**					
Type of Course	**SEC**					
Course Code	**MG4SECBCA200**					
Course Level	**NA**					
Course Summary	This course covers basic object-oriented programming concepts, swing and database connectivity.					
Semester	4	Credits			5	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		3	0	2	0	105
Pre-requisites, if any	Knowledge about programming logic					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
CO1:	Understand the fundamental concepts of object-oriented programming using Java.	U	2
CO2:	Utilize arrays, String, Vectors, Wrapper Classes and inheritance in Java programming	An	2
CO3:	Utilize packages, Exceptions and Threads in Java programming	An	2
CO4:	Apply basic java Programming concepts, Multithreading Exceptions, and packages for problem solving.	An	2
CO5:	Understand basic GUI and JDBC architecture, and develop Java GUI applications to communicate with databases using JDBC.	A	2

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

COURSE CONTENT

Theory Content for Classroom transaction (Units)

Module	Units	Course description	Hrs	CO No.
1	1.1	Concepts of Object-Oriented Programming, Benefits of OOP, Features of Java, Java Environment, defining a class, fields declaration, method declaration, creating object, accessing class members	6	1
	1.2	Decision Making, Branching & Looping: Decision Making with Control Statements, Looping statements, Jump in loops, Labelled loops.	2	1
	1.3	method overloading, constructors, constructor overloading, command line arguments, super keyword, static members	7	1
2	2.1	Arrays-one dimensional arrays, declaration, creation, initialization of arrays, two dimensional arrays.	5	2
	2.2	String class, Vectors, Wrapper Classes, Enumerated Types.	4	2
	2.3	Inheritance, overriding methods, dynamic method despatch, final (variables, methods and classes), abstract methods and classes, interfaces, visibility control	6	2
3	3.1	Packages: -Java API packages overview (lang, util, io, swing, applet), Creating and accessing packages, creating user defined packages, Adding class to a package.	5	3
	3.2	Exception Handling: Using the main keywords of exception handling: try, catch, throw, throws and finally; Nested try, Multiple catch statements, Creating user defined exceptions	4	3
	3.3	Multithreading-creation of multithreaded program-Thread class –Runnable interface-thread life cycle.	6	3
4	4.1	**Simple Java Programs:** 1. Read numeric data from user and output results.(Fibonacci series & Factorial etc.) 2. Numeric and String data as Command line arguments.	4	4
	4.2	1. Simple Programs using arrays: Sorting, searching, matrix operations, palindrome etc. 2. Programs to Utilize String Methods	6	4

	4.3	Programs to implement 1. Method Overloading, Constructor Overloading 2. Inheritance, Method overriding, Dynamic Method Despatch. 3.super, this, final and static keywords 4.Abstract class, interface, Package 5. Exception handling. 6.Multithreading	20	4
5	5.1	**Using NetBeans IDE Implement Simple Programs for Swing :** GUI programming using Swing-Window(Jframe, Jdialog), Containers(Jpanel, JtabbedPane, JscrollPane, JdesktopPane) Controls (Jlabel, JtextField, JtextArea, Jbutton, JcheckBox, JradioButton, Jlist, JcomboBox, Jtable), Layout managers (FlowLayout, BorderLayout, GridLayout, GridBagLayout, CardLayout, Null Layout)	20	5
	5.2	**Programs for Database Connectivity** JDBC – The Structured Query Language, The Connection Interface, The Prepared Statement Interface, ResultSets.	10	5

Teaching and Learning Approach	**Classroom Procedure (Mode of Transaction)** ICT Enabled lectures, Practical Sessions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) : 40 Marks** **CCA for Theory : 25 Marks** • Written Exam • Oral Presentations • Assignments **CCA for Practical : 15 Marks** • Lab assignments Based on Module 4.
	B. End Semester Examination **ESE for Theory: Written Test (50 Marks, 1.5 Hrs)** Part A: Very Short Answer Questions (Answer all) - (5*3=15 Marks) Part B: Short Answer Questions (4 out of 5 Questions) - (4*5=20 Marks) Part C: Essay Questions (1 out of 2 Questions) - (1*15=15 Marks) **ESE for Practical: 35 Marks (2 Hrs)** Question 1- (From Module 4): 10 Marks. Question 2- (From Module 5): 15 Marks. ***(Use NetBeans IDE for implementing the programs)*** Record: 5 Marks. Viva: 5 Marks.

REFERENCES:

1. Patrick Naughton – Java 2, The Complete Reference, Seventh Edition.

SUGGESTED READINGS::

1. Advanced Java Programming - Uttam K Roy, Oxford University Press; UK ed. Edition
2. E. Balagurusamy-Programming with Java, Third edition, McGraw Hill Publishers.
3. Cay S. Horstmann & Gary Cornell – Core Java Volume 1 – Fundamentals, Eighth edition.
4. K. Somasundaram – Programming in Java 2 , First edition, Jaico Publishing House.

	Mahatma Gandhi University **Kottayam**
Programme	**BCA (Honours)**
Course Name	**Probability Distributions and Statistical Inference**
Type of Course	**SEC**
Course Code	MG4SECBCA201
Course Level	NA
Course Summary	This course covers statistical concepts like data analysis, distributions, and hypothesis testing, enabling students to apply statistical methods to real-world problems.

Semester	4	Credits			4	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		4	0	0	0	60
Pre-requisites, if any	NIL					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
1	Analyse random variables, probability distributions, and statistical moments to model uncertainty, compute key metrics, and solve practical problems in data science and decision-making.	An	1
2	Apply key theoretical distributions to model real-world data, compute statistical properties, and solve probability problems—equipping them with essential tools for data analysis and predictive modelling.	A	1,2
3	Describe commonly used sampling distributions and their interrelationships.	U	1,2

4	Illustrate hypothesis testing, including types of hypotheses and errors, critical concepts like p-value and power, tests based on t, z, and chi-square distributions.	A	1,2
Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)			

COURSE CONTENT

Content for Classroom transactions (Units)

Module	Units	Course description	Hrs	CO No.
1		**Random Variables**		
	1.1	Random Variables: Definition of discrete and continuous random variables.	2	1
	1.2	Probability density(mass) function and distribution function (discrete case) with properties (without Proof),	4	1
	1.3	Expectation, variance and Moment generating function of a discrete random variable with properties (without proof), Related problems.	4	1
2		**Standard Probability Distributions**		
	2.1	Theoretical distributions: Discrete Distribution-Bernoulli, Binomial and Poisson-mean, variance, moment generating functions (without proof) and fitting of data, Problems based on the distributions.	9	2
	2.2	Problems based on the distributions, Continuous Distribution-Normal distribution, Important properties (without proof) of the distribution (mean, variance, moments, MGF, M.D. and Q.D, etc. fitting excluded).	5	2
	2.3	Area under the normal curve related problems.	4	2
3		**Sampling Distributions**		
	3.1	Sampling distribution, Statistic, Parameter, Standard Error.	2	3

	3.2	Sampling Distributions of Mean of the sample from Normal population and distribution of Variance (without derivation).	3	3
	3.3	Statement of the form of the distributions Z, t, Chi-square and F (form alone), properties (without derivation) and uses, Inter relationships.	8	3
4	**Testing of Hypothesis**			
	4.1	Statistical inference definition, Testing of hypotheses procedure, Statistical hypotheses, Simple and composite hypotheses, Null and Alternate hypothesis, Parametric and Non-parametric hypotheses.	2	4
	4.2	Type-1 and Type-II errors, Critical Region, One-tailed and Two-tailed tests, Size of the test, Significance level, P value, Power.	2	4
	4.3	Tests based on t and Z- Testing of Population mean (One sample and two samples).	4	4
	4.4	Testing of Population Proportion (One sample and Two samples), Paired sample t-test.	6	4
	4.5	Chi-square test of goodness of fit, Chi-square test of independence.	5	4

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Brainstorming lectures • Explicit teaching • Active Cooperative learning
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)** **CCA for Theory: 30 Marks** • Quiz / MCQ • Assignments • Tests

	B. End Semester Examination (ESE) **ESE for Theory: Written Test (70 Marks, 2 Hrs)** (Use of non-programmable calculator and statistical tables allowed) Part A: Answer any 5 questions out of 8. Each question carries 2 marks. (5 x 2 = 10 marks) Part B: Answer any 5 questions out of 8. Each question carries 6 marks. (5 x 6 = 30 marks). Part C: Answer any 2 questions out of 4. Each question carries 15 marks. (2 x 15 = 30 marks)

REFERENCES

1. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons
2. S.P. Gupta: Statistical Methods (Sultan Chand & Sons Delhi)
3. V.K. Rohatgi: An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
4. B.L. Agarwal: Basic Statistics, New Age International (p) Ltd.

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Programme	**BCA (Honours)**					
Course Name	**Design Thinking and Innovation**					
Type of Course	**SEC**					
Course Code	**MG4SECBCA202**					
Course Level	NA					
Course Summary	This course provides a comprehensive introduction to Design Thinking, a human-centered approach to innovation that integrates the needs of people, the possibilities of technology, and the requirements for business success. Students will explore creative thinking processes, problem-solving approaches, and the importance of customer-centricity in the modern business landscape.					
Semester	4	Credits			2	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	0	-	30
Pre-requisites, if any	Basic awareness of problem solving.					

COURSE OUTCOMES(CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
CO1:	Propose real-time innovative product designs and Choose appropriate frameworks, strategies, techniques during prototype development	An	1,3
CO2:	Know wicked problems and how to frame them in a consensus manner that is agreeable to all stakeholders using appropriate frameworks, strategies, techniques during prototype development.	An	1

CO3:	Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products.	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 transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1	Basics of Design Thinking: Understand the concept of innovation and its significance in business. Understanding creative thinking process and problem solving approaches. Know Design Thinking approach and its objective.	2	1
	2	Design Thinking and customer centricity – real world examples of customer challenges, use of Design Thinking to Enhance Customer Experience, Parameters of Product Experience, Alignment of Customer Expectations with Product.	4	1
	3	Discussion of a few global success stories like AirBnB, Apple, IDEO, Netflix etc. Explain the four stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement	4	1
2	1	Learning to Empathize and Define the Problem : Know the importance of empathy in innovation process – how can students develop empathy using design tools Observing and assimilating information	2	2
	2	Individual differences & Uniqueness Group Discussion and Activities to encourage the understanding, acceptance and appreciation of individual differences.	3	2
	3	What are wicked problems? Identifying wicked problems around us and the potential impact of their solution	3	2
	4	Know the various templates of ideation like brainstorming, systems thinking Concept of	2	2

		brainstorming – how to reach consensus on wicked problems		
3	1	Ideate, Prototype and Implement: Mapping customer experience for ideation. Know the methods of prototyping, purpose of rapid prototyping. Implementation	4	3
	2	Feedback, Re-Design & Re-Create: Feedback loop, focus on User Experience, address ergonomic challenges, user focused design	3	3
	3	Final concept testing, Final Presentation – Solving Problems through innovative design concepts & creative solution	3	3

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Use of ICT tools in conjunction with traditional classroom teaching methods • Interactive sessions • Class discussions
Assessment Types	**MODE OF ASSESSMENT** **A: Continuous Comprehensive Assessment (CCA)** **CCA for Theory : 15 Marks** ○ Written test ○ Assignments ○ Oral Presentations
	B. End Semester Examination **ESE for Theory : Written Test (35 Marks, 1 Hour)** **Part A: Short Answer Questions (7 out of 10 Questions) – (7*5=35 Marks)**

REFERENCES:

1. E Balaguruswamy (2023), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company .

2. Tim Brown, (2008), "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Harvard Business Review.

3. 8 steps to Innovation by R T Krishnan & V Dabholkar, Collins Publishing.

SUGGESTED READINGS:

1. Design Thinking by Nigel Cross, Bloomsbury.

	Mahatma Gandhi University Kottayam
Programme	**BCA (Honours)**
Course Name	**Data Visualization**
Type of Course	**DSE**
Course Code	**MG4DSEBCA200**
Course Level	NA
Course Summary	This course provides a comprehensive introduction to data visualization, covering various types of data and the entire data visualization process. The course also addresses the challenges and limitations of data visualization and offers an overview of popular visualization tools and data storytelling principles. Additionally, it introduces the Power BI interface, data transformations and preparations, data models and visualizations, and the process of publishing and sharing reports.

Semester	4	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	1	-	60
Pre-requisites, if any	Familiarity with using a computer, including file management and basic software navigation. Basic knowledge of data structures, such as tables and databases. Basic understanding of data analysis concepts and familiarity with data types.					

COURSE OUTCOME

CO No.	Expected Course Outcome	Learning Domains *	PO No
CO1:	Analyze the fundamentals of data visualization and its importance.	An	1
CO2:	Compare and contrast different types of visualizations and their appropriate uses.	An	2,3
CO3:	Use Power BI to create and customize various types of visualizations	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 transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1	Introduction to Data Visualization Definition and importance of data visualization-Role of data visualization in decision making, Types of data (numerical, categorical, temporal, geographical)-	2	1
	2	Data visualization process (data collection, exploration, analysis, visualization, interpretation)	4	1
	3	Challenges and limitations of data visualization	4	1
2	1	Visualization tools & Data Storytelling Overview of Visualization Tools (e.g., Excel, Tableau, Power BI, Python)- Comparing and contrasting features and Use Cases among these tools.	5	2
	2	Principles of Data Storytelling: Narrative and Context-Best Practices for Dashboard Layout and Interactivity.	5	2
	3	Designing Effective Visualizations Principles of Good Visualization Design.	3	2
	4	Understanding and Using Color in Visualizations	3	2
	5	Importance of Data Modelling in Visualization.	4	2
Practical Component: Lab Programs for Data Visualization Using Power BI				
3	1	**Introduction to Power BI Interface and Basics** 1. Installation and interface overview 2. Exploring the Power BI workspace: Ribbon, panes, and canvas. 3. Importing data from Excel and CSV files. 4. Introduction to multiple data sources 5. Basic report creation: Adding visuals and saving a report.	6	3
	2	**Data Transformation and Preparation** 1. Using Power Query Editor	6	3

		2. Cleaning data: Removing duplicates, handling missing values. 3. Transforming data: Splitting columns, changing data types, renaming columns. 4. Merging and appending queries. 5. Creating custom columns and calculated columns		
	3	**Data Modelling** 1. Creating relationships between tables 2. Identifying and resolving data inconsistencies 3. Creating calculated columns and measures	6	3
	4	**Creating Basic Visualizations** 1. Creating various chart types (bar, column, line, pie, area, etc.,) 2. Formatting and customizing visualizations	6	3
	5	**Publishing and Sharing Reports** 1. Publishing a report to Power BI Service. 2. Sharing reports and dashboards with team members. 3. Setting up data refresh schedules and managing permissions	6	3

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Use of ICT tools in conjunction with traditional classroom teaching methods • Interactive sessions • Class discussions
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **CCA for Theory : 15 Marks** • Written Exam • Oral Presentations • Assignments **CCA for Practical : 15 Marks** • Lab assignments
	B. End Semester Examination **ESE for Theory: Written Test (35 Marks, 1 Hr)** Part A: Very Short Answer Questions (5 out of 7) - (5*3=15 Marks) Part B: Short Answer Questions (4 out of 6 Questions) - (4*5=20 Marks)

	ESE for Practical: 35 Marks • Implementation: 15 Marks. • Record : 10 Marks • Viva : 10 Marks

REFERENCES:

1. "Storytelling with Data: A Data Visualization Guide for Business Professionals" Cole Nussbaumer Knaflic, Wiley; 1st edition, 2015.

2. “The Visual Display of Quantitative Information” by Edward Tufte, Graphics Press USA; 2nd edition, 2001.

SUGGESTED READINGS:

1. "Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press, 2018.

2. "Analyzing Data with Power BI and Power Pivot for Excel", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017.

3. "Microsoft Power BI Complete Reference", Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition, 2018.

WEB RESOURCES:

1. https://learn.microsoft.com/en-us/power-bi/

2. https://www.storytellingwithdata.com/

3.https://jpsm.umd.edu/sites/jpsm.umd.edu/files/syllabi/Syllabus_Introduction%20to%20 Data%20Visualization_Spring%202024.pd

	Mahatma Gandhi University Kottayam
Programme	**BCA (Honours)**
Course Name	**Introduction to Machine Learning**
Type of Course	**DSE**
Course Code	**MG4DSEBCA201**
Course Level	NA
Course Summary	This course provides a comprehensive overview of machine learning, covering both theoretical concepts and practical applications, preparing students to apply ML techniques in various domains.

Semester	4	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	1	-	60
Pre-requisites, if any	Basic knowledge of statistics and probability. Familiarity with fundamental programming concepts and proficiency in Python. With libraries such as NumPy, pandas, Scikit-Learn, NLTK, Matplotlib, and Seaborn					

COURSE OUTCOMES(CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
CO1:	Define and explain machine learning concepts, types, and basic metrics.	An	1
CO2:	Understand supervised and unsupervised learning techniques	An	1
CO3:	Implement and evaluate supervised learning techniques, including K-Nearest Neighbors, linear regression, and logistic regression, and measure model performance using accuracy, precision, recall, and F1 score.	A	1
CO4:	Apply and visualize clustering algorithms such as K-Means, hierarchical clustering, and DBSCAN on	A	2,3

	datasets. This practical application helps you understand their real world use.		
CO5:	Perform dimensionality reduction using Principal Component Analysis (PCA) and interpret the results.	A	2,3
CO6:	Develop and assess classification models using random forests, support vector machines, and neural networks	A	2,3
CO7	Demonstrate ensemble learning concepts through bagging with random forests and boosting with the AdaBoost algorithm	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 transactions (Units)

Module	Units	Course description	Hrs	CO No.
1	1	Introduction to Machine Learning Introduction: Definition, History and Application of Machine Learning,	2	1
	2	Types of Machine Learning: Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. Labeled and Unlabelled Dataset. Supervised Learning Tasks: Regression vs. Classification,	5	1
	3	Learning Framework: Training, Validation and Testing of ML models. Performance Evaluation Parameters: Confusion matrix, Accuracy, Precision, Recall, F1 Score, and AUC	8	1
2	1	Supervised Learning and Unsupervised Learning Regression: Linear and non-linear Regression, Logistic Regression. Classification: Naïve Bayes, K-Nearest Neighbors, Decision Trees.	3	2
	2	Linear model: Introduction to Artificial Neural Networks, Perceptron Learning Algorithm, Single Layer Perceptron, Introduction to Support Vector Machine for linearly separable data.	6	2
	3	Clustering: K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. ML Applications: Ethical Considerations in Machine Learning, Case study and Real-world Applications	6	2

Introduction to Machine Learning Lab				
3	1	1.Implement linear regression on a dataset and visualize the regression line. 2. Implement logistic regression on a binary classification dataset and plot the decision boundary.3 Implement and evaluate the performance of Decision tree ID3/Cart classifier for any given dataset. 4.Implement and evaluate the performance of the Naive Bayes Classifier on a given dataset.	5	3
	2	1.Implement K-Means clustering on a point dataset and visualize and evaluate the clusters. 2. Implement hierarchical clustering on a dataset and plot the dendrogram. 3. Implement DBSCAN clustering on a dataset and visualize and evaluate the clusters.	5	4
	3	1. Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction.	5	5
	4	1. Build and evaluate a random forest classifier using a numerical dataset. 2. Implement a support vector machine for linearly separable classes and visualize the margins and decision boundary	8	6
	5	1.Build a single layer perceptron model to classify AND, OR, and XOR problems (may use TensorFlow/Keras) and visualize their decision boundaries. Also evaluate its performance. 2. Demonstrate the concept of boosting using the AdaBoost algorithm	7	7

Teaching and Learning Approach	**Classroom Procedure (Mode of transaction)** • Use of ICT tools in conjunction with traditional classroom teaching methods • Interactive sessions • Class discussions
Assessment Types	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA) : 30 Marks** **CCA for Theory : 15 Marks** • Written Exam • Oral Presentations • Assignments **CCA for Practical : 15 Marks** • Lab assignments Based on Module 3.

	B. End Semester Examination **ESE for Theory: 35 Marks (1 Hour)** **Written Examination for Modules 1 and 2.** Part A: Very Short Answer Questions (5 out of 7) - (5*3=15 Marks) Part B: Short Answer Questions (4 out of 6 Questions) - (4*5=20 Marks) **ESE for Practical Component: 35 Marks** Lab Record : 10 Marks Viva : 25 Marks (5 Marks for each CO in Module 3, 5*5= 25 Marks) **(No Practical Examination)**

REFERENCES:

1.Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House.

2. Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House.

3. Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill.

4. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780

SUGGESTED READINGS:

1.Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN: 9781107422223, 2012.

2. Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.

3. Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning.

4. Chollet, F. (2018). Deep Learning with Python. Manning Publications.

5. Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.

6. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.

7. Géron, A. (2017). Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems* (1st ed.). O'Reilly Media

Mahatma Gandhi University
Kottayam

Programme	**BCA (Honours)**					
Course Name	**Web Programming –II**					
Type of Course	**DSE**					
Course Code	**MG4DSEBCA202**					
Course Level	NA					
Course Summary	This course covers the Node.js environment, the REPL terminal, Node.js modules, Node Package Manager (NPM), file management, event handling, database operations, and an introduction to the Express framework.					
Semester	4	Credits			3	Total Hours
Course Details	Learning Approach	Lecture	Tutorial	Practical	Others	
		2	0	1	0	60
Pre-requisites, if any	Basic Knowledge of JavaScript and OOPS					

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains *	PO No
Upon completion of this course, the students will be able to:			
1	Understand Node JS and REPL terminal and Experiment with Node JS Modules and Node Package Manager	U	1
2	Make use of Web Server to manage files.	U	1
3	Understand event handling and database operations	A	1,2
4	Develop applications in Node JS and Express	A	1,2
****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	Features and advantages of Node JS, Traditional Web Server Model, Node.js Process Model, Asynchronous programming with Node.js, Types of applications that can be developed using Node.js	2	1
	1.2	Primitive Types, Object Literal, Functions, NODE.JS MODULES: Module, Module Types: Core Modules, Local Modules, Third Party Modules, Module Exports. Using Modules in a Node.js File, Using the Built in HTTP, URL.	5	1
	1.3	Node Package Manager: NPM, Installing Packages Locally, Adding dependency in package.json, Installing packages globally, Updating packages.	3	1
2	2.1	Handling HTTP requests, Sending requests.	2	2
	2.2	File System-Reading, Writing a File, Writing a file asynchronously, Opening a file, deleting a file, Other IO Operations: Append, Rename, Truncate. File System Module with URL Module Create, Read, Remove a Directory.	5	2
3	3.1	EventEmitter class, Methods and Events of EvenEmitter Class, returning event emitter, Extend EventEmitter Class, Passing Arguments and 'this' to listeners, Asynchronous and Synchronous call, Handle Events only Once, Error Events	3	3
	3.2	Database Connectivity-Connection string, Configuring, working with insert, select command, updating records, delete records, drop tables, Ordered Result Set	4	3
	3.3	Express And Node Js-Introduction to Express Framework, Express Server Request-Response Routes, Route Parameters, Multiple Route Callback/Handler Functions, Methods of Response Object, Chaining Route Handlers, Send Static Files, Accept User Input, Send file as a response, Templates and Express.	6	3

4	4.1	Explore the Node.js REPL, Use Core Modules, Create and Import Custom Modules, Install and Use a Third-Party Module, Install a local package (e.g., chalk for colorful console output), Add dependencies in package.json and update them, Install a global package (e.g., nodemon) and use it to run a server, Create file and perform read and write operations, Perform asynchronous file operations like appending and renaming,Create a directory, add files, and remove the directory.	10	4
	4.2	Create and Send HTTP requests using the http module, Create an EventEmitter instance (Handle a custom event with a listener, Pass arguments to the listener function.), Implement an EventEmitter that triggers events based on asynchronous tasks (e.g., file read completion), Handle error events, Set up a connection to a database (e.g., MySQL or MongoDB) and Perform basic CRUD operations.	10	4
	4.3	Build an Express server (Handles GET and POST routes, Sends JSON and HTML responses.), Implement route parameters and query string handling, send static files using Express, Accept and validate user input through forms, implement file upload functionality, use a template engine like Pug to render dynamic views.	10	4

Teaching and Learning Approach	**Classroom Procedure (Mode of Transaction)** Lecture & Lab Sessions
Assessment Types	**MODE OF ASSESSMENT** **Continuous Comprehensive Assessment (CCA)** **CCA for Theory : 15 Marks** • Written Exam • Oral Presentations • Assignments **CCA for Practical : 15 Marks** • Lab assignments
	B. End Semester Examination **ESE for Theory: Written Test (35 Marks, 1 Hour)** **Written Examination for Modules 1, 2 and 3.**

	Part A: Very Short Answer Questions (5 out of 7) - (5*3=15 Marks) Part B: Short Answer Questions (4 out of 6 Questions) - (4*5=20 Marks) **ESE for Practical: (35 Marks, 2 Hrs)** 1. Design & Development - 20 Marks 2. Viva- 10 Marks 3. Record - 5 Mark

REFERENCES:

1. Dhruti Shah, "Node.JS Guidebook", BPB Publications, 2018.

SUGGESTED READINGS:

1. Basarat Ali Syed, Beginning Node.js, A press, 2014,

WEB REFERENCES:

1. https://nodejs.org/en/docs/
2. https://www.tutorialsteacher.com/nodejs