TULSIRAMJI GAIKWAD-PATIL COLLEGE OF ENGINEERING & TECHNOLOGY
Wardha Road, Nagpur - 441108
Accredited with NAAC A+ Grade & NBA Accredited (EE, ME, CE & ECE)
Approved by AICTE, New Delhi, Govt. of Maharashtra
(An Autonomous Institution Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur)

An Autonomous Institute

Department of Computer Applications (UG)

Bachelor of Computer Applications
BCA

Teaching Scheme & Syllabus Sem IV

Considering

National Education Policy 2020

From

Academic Year 2026-27

Designed as per AICTE Model Curriculum 2024 for BCA

Vision of Institute

To emerge as a learning center of excellence in the national ethos in domains of science, technology and management.

Mission of Institute

- To strive for rearing standard and stature of the students by practicing high standards of professional ethics, transparency and accountability.
- To provide facilities and services to meet the challenges of industry and society.
- To facilitate socially responsive research, innovation and entrepreneurship.
- To ascertain holistic development of the students and staff members by inculcating knowledge and profession as work practices.

Vision of the Department

To be the source of bringing out globally competent pioneering computing professionals, researchers, innovators and entrepreneurs and thereby succeed and contribute value to the knowledge-based economy and society.

Mission of the Department

- To enhance the placement ratio of the department.
- To get more industry interaction and partnership with skill India mission.
- To enhance the teaching learning facilities with digital India mission.
- To promote technical culture in the department.
- To launch an international journal at departmental level.
- To increase the frequency of national/international level workshops and conferences.
- To promote visit of prominent personalities in the department at a more regular basis.

Sr. No.	Course category	Course Name	Course Code	Teaching Scheme (hrs.)			Total credits	% weightage			ESE Duration (hrs.)	TOTAL
				L	T	P		CT	CA	ESE		
1	DSC	Entrepreneurship and Startup Ecosystem	BCA12401	2	-	-	2	14	6	30	2	50
2	DSC	Computer Networks	BCA12402	3	-	-	3	30	10	60	3	100
3	DSC	Computer Networks Lab	BCA12403	-	-	4	2	-	25	25	2	50
4	DSC	Design and Analysis of Algorithm	BCA12404	2	-	-	2	14	6	30	3	50
5	DSC	Design and Analysis of Algorithm Lab	BCA12405	-	-	2	1	-	25	25	2	50
6	DSC	Artificial Intelligence	BCA12406	3	-	-	3	30	10	60	3	100
7	DSC	Artificial Intelligence Lab	BCA12407	-	-	4	2	-	25	25	2	50
8	DSE*	Professional Elective – II	BCA12408-09	2	-	2	2	14	6	30	2	50
9	DSE*	Professional Elective Lab	BCA12410-11	-	-	2	1	-	25	25	1	50
10	SEC	Design Thinking and Innovation	BCA12412	1	1	-	2	14	6	30	2	50
				13	1	16	20	116	144	340	22	600

Course Category	DSC	SEC	AEC	MDE	VAC	DSE
Credits	16	2	0	0	0	2
Cumulative Summary	44	21	6	2	4	6

PROGRESSIVE TOTAL CREDITS: 63+20=83

				Oct, 2026	2.0	Applicable for AY 2026-27
Chairperson	Vice Principal / Director Academics	Director Administration	Principal	Date of Release	Version	

Students can choose their specialization i.e. stream with Discipline Specific Elective (DSE) from Third year onwards as indicated in Appendix –I.

	Tulsiramji Gaikwad-Patil College of Engineering and Technology WardhaRoad,Nagpur-441108 **NAAC Accredited with A+ Grade** **(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)**	

Program: Bachelor in Computer Application Semester–IV

Teaching Scheme		**BCA12401 :Entrepreneurship and Startup Ecosystem**	**Examination Scheme**	
Lecture	2 Hrs./Week		**CT-I**	07Marks
Tutorial	-		**CT-II**	07 Marks
Total Credits	2		**CA**	06 Marks
Duration of ESE: 2Hrs.			**ESE**	30 Marks
			Total	**50 Marks**

Course Objectives:

1.	To understand Entrepreneurship and its types
2.	To understand that not all ideas can be turned into viable business models and guestimate business potential of an idea
3.	To understand different type of finances available and financing methods and know what is a Family Business and how is it different from Entrepreneurship

Course Contents

Unit-I	**Introduction to Entrepreneurship & Family Business:** Definition and Concept of entrepreneurship, Entrepreneur Characteristics, Classification of Entrepreneurs. Role of Entrepreneurship in Economic Development –Start-ups. Knowing the characteristics of Family business with discussion on few Indian cases of Family Business like Murugappa, Dabur, Wadia, Godrej, Kirloskar etc.
Unit-II	**Evaluating Business opportunity:** Sources of business ideas and opportunity recognition. Guesstimating the market potential of a business idea , Feasibility analysis of the idea .Industry, competition and environment analysis
Unit-III	**Building Blocks of starting ventures:** Low cost Marketing using digital technologies , Team building from scratch ,Venture Funding ,Establishing the value-chain and managing operations , Legal aspects like IPR and compliances **Start-up Ecosystem :**Know the components of the start-up ecosystem including Incubators, Accelerators, Venture Capital Funds, Angel Investors etc. , Know various

Text Books

T.1	Entrepreneurship, Rajeev Roy, Oxford University Press
T.2	Entrepreneurship: Successfully Launching New Ventures by R. Duane Ireland Bruce R. Barringer, Pearson Publishing

Reference Books

R.1	Family Business Management by Rajiv Agarwal, Sage Publishing
R.2	Ramachandran, K, Indian Family Businesses: Their survival beyond three generations, ISB Working Paper Series

Useful Links	
1	https://www.startpu_india.gov.in

	Course Outcomes	CL	Class Session
BCA12401.1	Understand basic building blocks of creating a venture	2	10
BCA12401.2	Identify a business opportunity and translate it into a viable business model	3	10
BCA12401.3	Identify the elements of the Indian entrepreneurship ecosystem and take relevant benefits from the constituents Know the legacy of family businesses	3	10

Tulsiramji Gaikwad-Patil College of Engineering and Technology
WardhaRoad,Nagpur-441108
NAAC Accredited withA+Grade
(An Autonomous Institute Affiliated to RTM Nagpur University,Nagpur)

Program: Bachelor in Computer Application Semester–IV

Teaching Scheme		BCA12402: Computer Networks	Examination Scheme	
Lecture	3 Hrs./Week		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3Hrs.			ESE	60 Marks
			Total	100 Marks

Course Objectives:

1.	To understand the fundamental concepts of Computer Networks and their applications.
2.	To understand the concepts of network design, implementation, and troubleshooting.
3.	To understand network protocols and the configuration of network devices
4.	To understand the role of emerging network technologies in planning and handling uncertainty.

Course Contents

Unit-I	**Overview of Computer Networks:** Definition and Objectives, Applications and Examples Network Components and Architecture **Network Models:** OSI Model: Layers and Functions, TCP/IP Model: Layers and Functions Comparison between OSI and TCP/IP Models **Network Topologies**: Physical vs. Logical Topologies, Common Topologies: Star, Ring, Bus, Mesh, Hybrid, Advantages and Disadvantages of Each Topology **Data Transmission**: Analog vs. Digital Signals, Transmission Modes: Simplex, Half-Duplex, Full-Duplex, Bandwidth and Latency **Networking Devices**: Routers, Switches, Hubs, Bridges, Gateways, Functions and Configurations of Each Device.
Unit-II	**Data Link Layer Fundamentals:** Functions of the Data Link Layer, Framing, Error Detection, and Error Correction, Flow Control Mechanisms. **Etherne**t: Ethernet Standards and Frame Structure, MAC Addressing and ARP, Ethernet Switching: Basic Concepts and Methods **Network Protocols**: Introduction to TCP/IP Protocol Suite, IP Addressing: IPv4 and IPv6 Subnetting and CIDR Notation **Address Resolution Protocol (ARP):** ARP Operation and Table, ARP Spoofing and Security Considerations.
Unit-III	**Network Layer and Transport Layer** **Network Layer:** IP Routing: Static vs. Dynamic Routing, Routing Protocols: RIP, OSPF, BGP, Network Address Translation (NAT) **Transport Layer:** TCP vs. UDP: Characteristics and Use Cases, TCP Handshake and Connection Management, Flow Control and Congestion Control in TCP **Congestion Control Algorithms**: Techniques: Slow Start, Congestion Avoidance, Fast Retransmit, Fast Recovery, TCP Variants: TCP Reno, TCP Vegas. **Network Management**: SNMP: Simple Network Management Protocol, Network Monitoring Tools and Techniques**.**

Unit-IV	**Application Layer and Emerging Technologies** **Application Layer Protocols:** HTTP/HTTPS: Structure and Operation, FTP, SMTP, POP3, IMAP: Protocols and Uses, DNS: Domain Name System and Resolution **Network Applications**: Web Browsing, Email Communication, File Transfer, Voice over IP (VoIP) and Streaming. **Emerging Technologies**: Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT) and Its Impact on Networking

Text Books	
T.1	Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2011.
T.2	James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson, 2021.
Reference Books	
R.1	Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education, 2012.
R.2	Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2019.
Useful Links	
1	Cisco Networking Academy - Online Courses and Resources
2	NetworkLessons.com - Tutorials on Various Networking Topics

	Course Outcomes	**CL**	**Class Session**
BCA12402.1	Understand the fundamental concepts of Computer Networks and their applications.	2	10
BCA12402.2	Develop problem-solving skills related to network design, implementation, and troubleshooting.	3	10
BCA12402.3	Implement network protocols and configure network devices.	3	10
BCA12402.4	Obtain insights about Planning and handling uncertainty through emerging technology of network.	2	10

Tulsiramji Gaikwad-Patil College of Engineering and Technology
WardhaRoad,Nagpur-441108
NAAC Accredited with A+Grade
(An Autonomous Institute Affiliated to RTM Nagpur University,Nagpur)

Program: Bachelor in Computer Application Semester–IV

Teaching Scheme		BCA12403 :Computer Networks Lab	Examination Scheme	
Lecture	4 Hrs./Week		CT-I	-
Tutorial	-		CT-II	-
Total Credits	2		CA	25 Marks
Duration of ESE: 3Hrs.			ESE	25 Marks
			Total	100 Marks

Course Objectives:

1.	To understand the fundamental concepts of Computer Networks and their applications.
2.	To understand the concepts of network design, implementation, and troubleshooting..
3.	To understand network protocols and the configuration of network devices..
4.	To understand the role of emerging network technologies in planning and handling uncertainty.

List of Practical

1	**Configure Basic Network Settings:** a) IP Address Configuration b) Subnet Mask and Gateway Settings
2	**Implement Network Protocols:** a) Write a simple Python script to perform DNS resolution. b) Implement a basic HTTP client-
3	**Network Simulation:** a) Use network simulation tools (e.g., Cisco Packet Tracer) to design and simulate network topologies. b) Configure routers and switches in a simulated environment.
4	**Performance Measurement:** a) Measure network performance using tools like `ping`, `traceroute`, and `iperf`. b) Analyze network traffic using Wireshark.
5	**Configure and Implement VLANs:** a) Configure VLANs on a switch and verify using simulation tools.
6	**Set Up a Simple Web Server:** a) Deploy a basic web server and configure HTTP/HTTPS access.
7	**Network Security Lab:** Implement basic firewall rules and VPN configurations.
8	Perform vulnerability scanning and analyze results.
9	**Network Troubleshooting:** Diagnose and resolve common network issues.
10	Use troubleshooting commands and techniques to fix connectivity problems.

Text Books

T.1	Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2011.
T.2	James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson, 2021.
Reference Books	
R.1	Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education, 2012.
R.2	Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2019.
Useful Links	
1	Cisco Networking Academy - Online Courses and Resources
2	NetworkLessons.com - Tutorials on Various Networking Topics

	Course Outcomes	CL	Class Session
BCA12403.1	Understand the fundamental concepts of Computer Networks and their applications.	2	10
BCA12403.2	Develop problem-solving skills related to network design, implementation, and troubleshooting.	3	10
BCA12403.3	Implement network protocols and configure network devices.	3	10
BCA12403.4	Obtain insights about Planning and handling uncertainty through emerging technology of network.	2	10

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
NAAC Accredited with A+ Grade
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

Program: Bachelor in Computer Application Semester – IV

Teaching Scheme		BCA12404 : Design and Analysis of Algorithm	Examination Scheme	
Lecture	2 Hrs./Week		CT-I	07Marks
Tutorial	-		CT-II	07 Marks
Total Credits	2		CA	06 Marks
Duration of ESE: 2 Hrs.			ESE	30 Marks
			Total	50 Marks

Course Objectives:

1.	To understand the basic algorithm design paradigms.
2.	To understand the basic concepts of algorithm analysis.
3.	To understand the process of designing efficient algorithms for common design situations and real-life problems.

Course Contents

Unit I	Define the concept of an algorithm ? Design and performance analysis of algorithms, time complexity, space complexity. **Asymptotic notations** (O, Ω, Θ) to measure growth of a function and application to measure complexity of algorithms. Analysis of sequential search, bubble sort, selection sort, insertion sort, matrix multiplication. Recursion: Basic concept. Analysis of recursive algorithms, Master's theorem.
Unit II	**The Divide & Conquer Design Technique:** The general concept. Binary search, finding the maximum and minimum, merge sort, quick sort. Best and worst case analysis for the mentioned algorithms. Strassen's matrix multiplication. Lower bound for comparison-based sorting. **The Greedy Design Technique:** The general concept. Applications to general Knapsack problem, finding minimum weight spanning trees: Prim's and Kruskal's algorithms, Dijkstra's algorithm for finding single source shortest paths problem.
Unit III	**The Dynamic Programming Design Technique:** The general concept. Computation of Fibonacci series and Binomial coefficients, all pair shortest paths problem (Floyd-Warshall's algorithm), 0/1 Knapsack problem. **Algorithms on Graphs:** Breadth First Search, Depth First Search, finding connected components, depth first search of a directed graph, topological sorting.

Text Books

T.1	Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook)
T.2	Cormen Thomas H., Leiserson Charles E., Rivest Ronald L. and Stein Clifford, Introduction to Algorithms, PHI publication, 3rd Edition, 2009.

T.3	Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd., 2012.
Reference Books	
R.1	Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston, 1983.
R.2	Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education, 2006.
Useful Links	
1	https://nptel.ac.in/courses/106101060
2	https://www.cs.umd.edu/~mount/451/Lects/451lects.pdf

	Course Outcomes	CL	Class Sessions
BCA12404.1	Apply asymptotic notations and complexity analysis to evaluate algorithm efficiency.	03	10
BCA12404.2	Apply divide-and-conquer and greedy techniques to solve computational problems.	03	10
BCA12404.3	Apply graph algorithms for traversal, connected components, and topological sorting..	03	10

Program: Bachelor in Computer Application Semester–IV

Teaching Scheme		Name of Course	Examination Scheme	
Lecture	2 Hrs./Week	**BCA12405 : Design and Analysis of Algorithm Lab**	**CT-I**	-
Tutorial	-		**CT-II**	-
Total Credits	**1**		**CA**	25
Duration of ESE : 2 Hrs			**ESE**	25
			Total	**50 Marks**

Course Objectives:

1.	To understand the fundamental concepts of algorithm design and analysis, including time complexity,space complexity, and asymptotic notations.
2.	To implement searching and sorting algorithms and analyze their performance.
3.	To apply divide-and-conquer and dynamic programming techniques to solve computational problems.
4.	To implement graph algorithms for finding minimum spanning trees, shortest paths, and graph traversal.
5	To develop problem-solving skills by designing, implementing, and analyzing efficient algorithms.

Course Contents

1.	Implement Sequential Search and analyze its time complexity.
2.	Implement Bubble Sort to sort a list of elements.
3.	Implement Binary Search using the Divide and Conquer technique.
4.	Implement Insertion Sort and analyze its time complexity.
5.	Implement Merge Sort using the Divide and Conquer technique.
6.	Find the Maximum and Minimum elements in an array using the Divide and Conquer technique.
7.	Implement Prim’s Algorithm to find the Minimum Spanning Tree of a graph.
8.	Implement Dijkstra’s Algorithm to find the shortest paths from a single source vertex.
9.	Implement Breadth-First Search (BFS) to traverse a graph.
10.	Compute the Fibonacci series using Dynamic Programming.

TextBooks

T.1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, PHI Publication, 3rd Edition, 2009.

T.2	Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook).

ReferenceBooks	
R.1	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Addison-Wesley Publications, Boston, 1983.
R.2	Jon Kleinberg and Éva Tardos, Algorithm Design, Pearson Education, 2006.
UsefulLinks	
1	NPTEL – Design and Analysis of Algorithms
2	University of Maryland – Algorithm Lecture Notes

	Course Outcomes	**CL**	**Class Session**
CO1	Implement searching and sorting algorithms and analyze their complexity.	4	8
CO2	Apply divide-and-conquer techniques to solve problems using binary search, merge sort, and min-max finding.	3	7
CO3	Implement Prim's, Dijkstra's, and BFS algorithms to solve graph problems. .	3	8
CO4	Apply dynamic programming to solve problems such as the Fibonacci series.	3	2
CO5	Design and analyze efficient algorithms using appropriate techniques. .	6	2

Tulsiramji Gaikwad-Patil College of Engineering and Technology
WardhaRoad,Nagpur-441108
NAAC Accredited withA+Grade
(An Autonomous Institute Affiliated to RTM Nagpur University,Nagpur)

Program: Bachelor in Computer Application Semester–IV

Teaching Scheme		BCA12406 :Artificial Intelligence	Examination Scheme	
Lecture	3 Hrs./Week		**CT-I**	15 Marks
Tutorial	-		**CT-II**	15 Marks
Total Credits	**3**		**CA**	10 Marks
Duration of ESE: 3Hrs.			**ESE**	60 Marks
			Total	**100 Marks**

Course Objectives:

1.	To understand the fundamental concepts of Artificial Intelligence, intelligent agents, knowledge-based agents, and problem-solving agents.
2.	To apply various search algorithms, adversarial search techniques, constraint satisfaction methods, and evolutionary algorithms to solve AI problems.
3.	To apply logical reasoning, inference, and planning techniques and understand methods for handling uncertainty in AI systems.
4.	To explore major AI domains and applications, understand expert systems, and identify the legal and ethical issues associated with AI.

Course Contents

Unit-I	Introduction to Al What is AI? Intelligent Agents: Agents and environment, the concept of Rationality, the nature of environment, the structure of Agents. Knowledge-Based Agents: Introduction to Knowledge-Based Agents, The Wumpus World as an Example World. Problem-solving: Problem-solving agents.
Unit-II	Uninformed Search: DFS, BFS, Iterative Deepening Search. Informed Search: Best First Search, A* search, AO* search. Adversarial Search & Games: Two-player zero-sum games, Minimax Search, Alpha-Beta pruning. Constraints and Constraint Satisfaction Problems (CSPs), Backtracking search for CSP. Evolutionary Search Techniques: Introduction to evolutionary algorithms, Genetic algorithms, Applications of evolutionary search in AI.
Unit-III	Logical Reasoning and Uncertainty Logic: Propositional logic, First-order predicate logic, Propositional versus first-order inference, Unification and lifting. Inference: Forward chaining, Backward chaining, Resolution, Truth maintenance systems. Introduction to Planning: Blocks World problem, Strips; Handling Uncertainties: Non-monotonic reasoning, Probabilistic reasoning, Introduction to Fuzzy set theory.
Unit-IV	Domains and Applications of AI Domains in AI: Introduction to Machine Learning, Computer Vision, Robotics, Natural Language Processing, Deep Neural Networks, and their Applications. Expert Systems: The architecture and role of expert systems include two case studies. Legal and Ethical Issues: Concerns related to AI.

Text Books

T.1	M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook).

T.2	Nilsson Nils J, Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.
Reference Books	
R.1	Trivedi, M.C., Introduction to AI and Machine Learning, Khanna Book Publishing Company, 2024.
R.2	Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd edition, Prentice Hall
Useful Links	
1	https://nptel.ac.in/courses/106108705
2	https://www.cse.iitd.ac.in/~mausam/courses/col333/autumn2023/

	Course Outcomes	CL	Class Session
BCA12406.1	Understand the characteristics of rational agents, and the environment in which they operate, and gain insights about problem-solving agents	2	10
BCA12406.2	Gain insights about Uninformed and Heuristic search techniques and apply them to solve search applications.	3	10
BCA12406.3	Apply propositional logic and predicate calculus for knowledge representation and reasoning.	3	10
BCA12406.4	Obtain insights about Planning and handling uncertainty through probabilistic reasoning and fuzzy sets.	2	10

Program :Bachelor in Computer Application Semester–IV

Semester	Course Code	Name of Course	L	T	P	Credit
IV	BCA12407	Artificial Intelligence Lab	0	0	4	2

Course Objectives:

1.	To understand the fundamental concepts of Artificial Intelligence, intelligent agents, knowledge-based agents, and problem-solving agents.
2.	To apply various search algorithms, adversarial search techniques, constraint satisfaction methods, and evolutionary algorithms to solve AI problems.
3.	To apply logical reasoning, inference, and planning techniques and understand methods for handling uncertainty in AI systems.
4.	To explore major AI domains and applications, understand expert systems, and identify the legal and ethical issues associated with AI.

Course Contents

1.	Demonstrate basic problem-solving using Breadth-First Search on a simple grid
2.	Implement Depth-First Search (DFS) on a small graph.
3.	Solve the Water Jug Problem using Breadth First Search (BFS).
4.	Implement a Hill Climbing search to find the peak in a numeric dataset.
5.	Apply optimization techniques to find the maximum value in a list.
6.	Implement a basic rule-based expert system for weather classification.
7.	Implement a basic AI agent with simple decision-making rules.
8.	Solve the 4 – Queens Problem as a CSP backtracking problem.
9.	Represent and evaluate propositional logic expressions.
10.	Implement a basic Rule-Based Chatbot.

Text Books

T.1	M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook).

T.2	Nilsson Nils J, Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4.
Reference Books	
R.1	Trivedi, M.C., Introduction to AI and Machine Learning, Khanna Book Publishing Company, 2024.
R.2	Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd edition, Prentice Hall
Useful Links	
1	https://www.cse.iitd.ac.in/~mausam/courses/col333/autumn2023/
2	https://www.cse.iitd.ac.in/~mausam/courses/col333/autumn2023/

	Course Outcomes	CL	Class Session
CO1	Apply Uninformed Search Algorithms and Implement Heuristic Search techniques	3	9
CO2	Analyze and Solve Constraint Satisfaction Problems	4	9
CO3	Develop Rule-Based Systems	6	9
CO4	Evaluate optimization techniques.	5	9
CO5	Apply and illustrate the NLP concepts	3	9

Program: Bachelor of Computer Application

Semester	Course Code	Name of Course	L	T	P	Credits
IV	BCA12408	Data Visualization	2	-	-	2

Course Objectives:

1.	To understand the fundamentals of data visualization and its importance.
2.	To Learn about visual perception and its impact on data interpretation.
3.	To explore the ethical considerations and challenges in data visualization
4.	To study different types of visualizations and their appropriate uses.
5.	To utilize Power BI to create and customize various types of visualizations

Course Contents

Unit I	**Introduction to Data Visualization**: Definition and importance of data visualization-Role of data visualization in decision makingTypes of data (numerical, categorical, temporal, geographical)-Data visualization process (data collection, exploration, analysis, visualization, interpretation)-Challenges and limitations of data visualization
Unit II	**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. Principles of Data Storytelling: Narrative and Context-Best Practices for Dashboard Layout and Interactivityhy.
Unit III	**Designing Effective Visualizations:** Principles of Good Visualization Design - Understanding and Using Color in Visualizations – Importance of Data Modelling in Visualization.

Text Books

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.

Reference Books

1.	"Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press
2.	"Data Science and Data Analytics Using Python", M.C. Trivedi, Khanna Publications.

3.	"Analyzing Data with Power BI and Power Pivot for Excel", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017
4.	"Microsoft Power BI Complete Reference", Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition, 2018.
Useful Links	
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%20Data%20Visualization_Spring%202024.pd

	Course Outcomes	CL	Class Session
BCA12408.1	Explain the fundamentals, importance, and challenges of data visualization.	2	10
BCA12408.2	Apply data storytelling and design principles to create effective visualizations.	3	10
BCA12408.3	Create effective Power BI visualizations using appropriate colors, layouts, and data modelling.	6	10

	Tulsiramji Gaikwad-Patil College of Engineering and Technology Wardha Road, Nagpur-441108 **NAAC Accredited with A+ Grade** **(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)**	

Program :Bachelor in Computer Application Semester–IV

Teaching Scheme		**BCA12409: Introduction to Machine Learning**	**Examination Scheme**	
Lecture	3Hrs./Week		**CT-I**	7 Marks
Tutorial	-		**CT-II**	7 Marks
Total Credits	**2**		**CA**	6 Marks
Duration of ESE: 2Hrs.			**ESE**	30 Marks
			Total	**50 Marks**

Course Objectives:

1.	To introduce the fundamental concepts, history, types, and real-world applications of Machine Learning.
2.	To develop an understanding of supervised and unsupervised learning techniques, including regression, classification, and clustering algorithms.
3.	To implement basic Machine Learning algorithms, including Linear Regression, Logistic Regression, K-Nearest Neighbors, Naïve Bayes, and Decision Trees..

Course Contents

Unit I	**Introduction to Machine Learning - Introduction**: Definition, History and Application of Machine Learning, **Types of Machine Learning**: Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. Labeled and Unlabelled Dataset. **Supervised Learning Tasks:** Regression vs. Classification, Learning Framework: Training, Validation and Testing of ML models. **Performance Evaluation Parameters**: Confusion matrix, Accuracy, Precision, Recall, F1 Score, and AUC.
Unit II	**Regression:** Linear and Non-linear Regression, Logistic Regression.**Classification:** Naïve Bayes, K-Nearest Neighbors, Decision Trees.**Linear Model:** Introduction to Artificial Neural Networks, Perceptron Learning Algorithm, Single Layer Perceptron.**Support Vector Machine:** Introduction to Support Vector Machine for Linearly Separable Data.
Unit III	**Unsupervised Learning and ML Applications Clustering**: K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. **ML Applications**: Ethical Considerations in Machine Learning, Case Study and Real-world Applications.

Text Books

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

T.2	Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House.
T.3	Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill.
Reference Books	
R.1	Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN: 9781107422223, 2012.
R.2	Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
R.3	Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning.
Useful Links	
1	https://khannabooks.com/product/introduction-to-machine-learning-using-python/
2	https://www.google.com/search?q=Rajiv+Chopra+Machine+Learning+and+Machine+Intelligence+Khanna+Publishers

	Course Outcomes	CL	Class Session
BCA12409.1	Apply machine learning concepts, types, and basic evaluation metrics..	3	10
BCA12409.2	Apply supervised learning algorithms such as KNN, Linear Regression, and Logistic Regression.	3	10
BCA12409.3	Apply unsupervised learning algorithms such as K-Means, Hierarchical Clustering, and Association Rule Mining.	3	10

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road,Nagpur-441108
NAAC Accredited (A+ Grade)
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

Program: Master in Computer Application

Semester	Course Code	Name of Course	L	T	P	Credits
IV	BCA12410	Lab Programs for Data Visualization Using Power BI	-	-	3	2

Course Objectives:

1.	To introduce students to the Power BI interface and develop skills in importing data from various sources.
2.	To develop practical skills in data cleaning, transformation, and modeling using Power Query and Power BI
3.	To enable students to create interactive visualizations and dashboards, and publish and share reports for effective data-driven decision-making.

Course Contents

Sr.No.	List of Experiments	CO
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.	CO1, CO3
2.	**Data Transformation and Preparation** 1. Using Power Query Editor 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.	CO2, CO3
3.	**Data Modeling** 1. Creating relationships between tables 2. Identifying and resolving data inconsistencies 3. Creating calculated columns and measures	CO2,
4.	**Creating Basic Visualizations** 1. Creating various chart types (bar, column, line, pie, area, etc.,) 2. Formatting and customizing visualizations	CO3, CO4
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.	CO3, CO4

TextBooks

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.

ReferenceBooks

1.	"Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press
2.	"Data Science and Data Analytics Using Python", M.C. Trivedi, Khanna Publications.
3.	"Analyzing Data with Power BI and Power Pivot for Excel", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017
4.	"Microsoft Power BI Complete Reference", Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition, 2018.
UsefulLinks	
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

	Course Outcomes	CL	Class Session
BCA12410.1	Demonstrate data import and data transformation techniques using Power BI.	3	10
BCA12410.2	Apply data modeling and data cleaning techniques to prepare datasets for visualization.	3	10
BCA12410.3	Create interactive visualizations, dashboards, and reports using Power BI.	6	10

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441108
NAAC Accredited with A+ Grade
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

Program :Bachelor in Computer Application Semester–III

Semester	Course Code	Name of Course	L	T	P	Credit
IV	BCA12411	Introduction to Machine Learning Lab	0	0	4	2

Course Objectives:

1.	To implement linear and logistic regression algorithms for prediction and classification tasks.
2.	To understand and implement Decision Tree, Naive Bayes, Random Forest, and Support Vector Machine (SVM) classifiers.
3.	To apply evaluation metrics to assess the performance of machine learning models.

Course Contents

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.	Build and evaluate a random forest classifier using a numerical dataset
6.	Implement a support vector machine for linearly separable classes and visualize the margins and decision boundary
7.	Implement K-Means clustering on a point dataset and visualize and evaluate the clusters
8.	Implement hierarchical clustering on a dataset and plot the dendrogram.
9.	Implement DBSCAN clustering on a dataset and visualize and evaluate the clusters.
10.	Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction

Text Books

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

	Course Outcomes	CL	Class Session
BCA12410-11.1	Apply supervised learning techniques and evaluate model performance.	3	10
BCA12410-11.2	Apply clustering algorithms to analyze and visualize datasets.	3	10
BCA12410-11.3	Apply PCA for dimensionality reduction and interpret the results.	3	10

	Tulsiramji Gaikwad-Patil College of Engineering and Technology WardhaRoad,Nagpur-441108 **NAAC Accredited with A+ Grade** **(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)**	

Program: Bachelor in Computer Application Semester–IV

Teaching Scheme		**BCA12412 : Design Thinking and Innovation**	**Examination Scheme**	
Lecture	2 Hrs./Week		**CT-I**	07 Marks
Tutorial	-		**CT-II**	07 Marks
Total Credits	2		**CA**	06 Marks
Duration of ESE: 2Hrs.			**ESE**	30 Marks
			Total	**50 Marks**

Course Objectives:

1.	To introduce students to design-based thinking approach to solve problems
2.	To observe and assimilate unstructured information to well framed solvable problems
3.	To introduce student to templates of ideation

Course Contents

Unit-I	**Basics of Design Thinking** **1.** Understand the concept of innovation and its significance in business 2. Understanding creative thinking process and problem solving approaches 3. Know Design Thinking approach and its objective 4. 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. 5. Discussion of a few global success stories like AirBnB, Apple, IDEO, Netflix etc. 6. Explain the four stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Implement
Unit-II	**Learning to Empathize and Define the Problem** 1. Know the importance of empathy in innovation process – how can students develop empathy using design tools 2. Observing and assimilating information 3. Individual differences & Uniqueness Group Discussion and Activities to encourage the understanding, acceptance and appreciation of individual differences. 4. What are wicked problems 5. Identifying wicked problems around us and the potential impact of their solutions

Unit-III	**Ideate, Prototype and Implement** 1. Know the various templates of ideation like brainstorming, systems thinking 2. Concept of brainstorming – how to reach consensus on wicked problems 3. Mapping customer experience for ideation 4. Know the methods of prototyping, purpose of rapid prototyping. 5. Implementation
Text Books	
T.1	E Balaguruswamy (2023), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company
T.2	Tim Brown, (2008), "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", *Harvard Business Review*
Reference Books	
R.1	Design Thinking by Nigel Cross, Bloomsbury
R.2	steps to Innovation by R T Krishnan & V Dabholkar, Collins Publishing

	Course Outcomes	**CL**	**Class Session**
BCA12412 .1	Design innovative products and select appropriate frameworks and techniques for prototype development.	6	10
BCA12412 .2	Analyze wicked problems and frame stakeholder-consensus solutions using appropriate frameworks and techniques.	4	10
BCA12412 .3	Analyze users' emotional experiences and expressions to support innovative product design.	4	10