

**MANONMANIAM SUNDARANAR UNIVERSITY**

**M.Sc.,  
COMPUTER SCIENCE  
with  
ARTIFICIAL INTELLIGENCE**

**SYLLABUS**

**FROM THE ACADEMIC YEAR**

**2023 - 2024**

**TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION,  
CHENNAI – 600 005**

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<b>TANSICHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION</b>	
<b>Programme</b>	<b>M.Sc., COMPUTER SCIENCE with ARTIFICIAL INTELLIGENCE</b>
<b>Duration</b>	<b>PG - Two Years</b>
<b>Programme Outcomes (POs)</b>	<p><b>PO1: Problem Solving Skill</b> Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.</p> <p><b>PO2: Decision Making Skill</b> Foster analytical and critical thinking abilities for data-based decision-making.</p> <p><b>PO3: Ethical Value</b> Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.</p> <p><b>PO4: Communication Skill</b> Ability to develop communication, managerial and interpersonal skills.</p> <p><b>PO5: Individual and Team Leadership Skill</b> Capability to lead themselves and the team to achieve organizational goals.</p> <p><b>PO6: Employability Skill</b> Inculcate contemporary business practices to enhance employability skills in the competitive environment.</p> <p><b>PO7: Entrepreneurial Skill</b> Equip with skills and competencies to become an entrepreneur.</p> <p><b>PO8: Contribution to Society</b> Succeed in career endeavors and contribute significantly to society.</p> <p><b>PO 9 Multicultural competence</b> Possess knowledge of the values and beliefs of multiple cultures and a global perspective.</p> <p><b>PO 10: Moral and ethical awareness/reasoning</b> Ability to embrace moral/ethical values in conducting one's life.</p>
<b>Programme Specific Outcomes (PSOs)</b>	<p><b>PSO1 – Placement</b> To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions.</p> <p><b>PSO 2 - Entrepreneur</b> To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.</p> <p><b>PSO3 – Research and Development</b> Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development.</p> <p><b>PSO4 – Contribution to Business World</b> To produce employable, ethical and innovative professionals to sustain in the dynamic business world.</p> <p><b>PSO 5 – Contribution to the Society</b> To contribute to the development of the society by collaborating with stakeholders for mutual benefit.</p>

**Template for P. G., Programmes**

Semester-I	Credit	Hours	Semester-II	Credit	Hours	Semester-III	Credit	Hours	Semester-IV	Credit	Hours
Core-I	5	7	Core-IV	5	6	Core-VII	5	6	Core-XI	5	6
Core-II	5	7	Core-V	5	6	Core-VIII	5	6	Core-XII	5	6
Core - III	4	6	Core - VI	4	6	Core - IX	5	6	Project with viva voce	7	10
Elective -I Discipline Centric	3	5	Elective - III Discipline Centric	3	4	Core - X	4	6	Elective - VI (Industry / Entrepreneurship) 20% Theory 80% Practical	3	4
Elective-II Generic:	3	5	Elective -IV Generic:	3	4	Elective - V Discipline Centric	3	3	Skill Enhancement course / Professional Competency Skill	2	4
			Skill Enhancement I	2	4	3.6 Skill Enhancement II	2	3	Extension Activity	1	
						3.7 Internship/ Industrial Activity	2	-			
	<b>20</b>	<b>30</b>		<b>22</b>	<b>30</b>		<b>26</b>	<b>30</b>		<b>23</b>	<b>30</b>
<b>Total Credit Points -91</b>											

**Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline  
Based Credits and Hours Distribution System  
for all Post – Graduate Courses including Lab Hours**

**First Year – Semester – I**

<b>Part</b>	<b>List of Courses</b>	<b>Credits</b>	<b>No. of Hours</b>
	Core – I	5	7
	Core – II	5	7
	Core – III	4	6
	Elective – I	3	5
	Elective – II	3	5
		<b>20</b>	<b>30</b>

**Semester-II**

<b>Part</b>	<b>List of Courses</b>	<b>Credits</b>	<b>No. of Hours</b>
	Core – IV	5	6
	Core – V	5	6
	Core – VI	4	6
	Elective – III	3	4
	Elective – IV	3	4
	Skill Enhancement Course [SEC] - I	2	4
		<b>22</b>	<b>30</b>

**Second Year – Semester – III**

<b>Part</b>	<b>List of Courses</b>	<b>Credits</b>	<b>No. of Hours</b>
	Core – VII	5	6
	Core – VIII	5	6
	Core – IX	5	6
	Core (Industry Module) – X	4	6
	Elective – V	3	3
	Skill Enhancement Course – II	2	3
	Internship / Industrial Activity	2	-
		<b>26</b>	<b>30</b>

**Semester-IV**

<b>Part</b>	<b>List of Courses</b>	<b>Credits</b>	<b>No. of Hours</b>
	Core – XI	5	6
	Core – XII	5	6
	Project with VIVA VOCE	7	10
	Elective – VI (Industry Entrepreneurship)	3	4
	Skill Enhancement Course – III / Professional Competency Skill	2	4
	Extension Activity	1	-
		<b>23</b>	<b>30</b>

**Total 91 Credits for PG Courses**

<b>METHODS OF EVALUATION</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	<b>25 Marks</b>
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	<b>75 Marks</b>
<b>Total</b>		<b>100 Marks</b>
<b>METHODS OF ASSESSMENT</b>		
<b>Remembering (K1)</b>	<p>The lowest level of questions require students to recall information from the course content</p> <p>Knowledge questions usually require students to identify information in the text book.</p>	
<b>Understanding (K2)</b>	<p>Understanding of facts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words.</p> <p>The questions go beyond ample recall and require students to combine data together</p>	
<b>Application (K3)</b>	<p>Students have to solve problems by using/ applying a concept learned in the classroom.</p> <p>Students must use their knowledge to determine a exact response.</p>	
<b>Analyze (K4)</b>	<p>Analyzing the question is one that asks the students to break down something into its component parts.</p> <p>Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations.</p>	
<b>Evaluate (K5)</b>	<p>Evaluation requires an individual to make judgment on something.</p> <p>Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem.</p> <p>Students are engaged in decision-making and problem-solving.</p> <p>Evaluation questions do not have single right answers.</p>	
<b>Create (K6)</b>	<p>The questions of this category challenge students to get engaged in creative and original thinking.</p> <p>Developing original ideas and problem solving skills</p>	

## **Testing Pattern (25+75)**

### **Internal Assessment**

**Theory Course:** For theory courses there shall be three tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA) for a maximum of 25 marks. The duration of each test shall be one / one and a half hour.

**Computer Laboratory Courses:** For Computer Laboratory oriented Courses, there shall be two tests in Theory part and two tests in Laboratory part. Choose one best from Theory part and other best from the two Laboratory part. The average of the best two can be treated as the CIA for a maximum of 25 marks. The duration of each test shall be one / one and a half hour.

There is no improvement for CIA of both theory and laboratory, and, also for University End Semester Examination.

## Written Examination : Theory Paper (Bloom's Taxonomy based)

### Question paper Model

<b>Intended Learning Skills</b>	<b>Maximum 75 Marks</b> <b>Passing Minimum: 50%</b> <b>Duration : Three Hours</b>
	<b>Part –A (10x 2 = 20 Marks)</b> Answer ALL Questions <b>Each Question carries 2 marks</b>
Memory Recall / Example/ Counter Example / Knowledge about the Concepts/ Understanding	Two questions from each UNIT
	<b>Question 1 to Question 10</b>
	<b>Part – B (5 x 5 = 25 Marks)</b> <b>Answer ALL Questions</b> <b>Each questions carries 5 Marks</b>
Descriptions/ Application (problems)	<b>Either-or Type</b> Both parts of each question from the same UNIT
	<b>Question 11(a) or 11(b)</b> To <b>Question 15(a) or 15(b)</b>
	<b>Part-C (3x 10 = 30 Marks)</b> <b>Answer any THREE questions</b> <b>Each question carries 10 Marks</b>
Analysis /Synthesis / Evaluation	There shall be FIVE questions covering all the five units
	<b>Question 16 to Question 20</b>

Each question should carry the course outcome and cognitive level

For instance,

1. [CO1 : K2] Question xxxx
2. [CO3 : K1] Question xxxx



**PROGRAMME OUTCOMES (PO) - PROGRAMME SPECIFIC OUTCOMES (PSO) MAPPING**

<b>PROGRAMME SPECIFIC OUTCOMES (PSO)</b>					
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>PSO1</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>PSO2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>PSO3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>PSO4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>PSO5</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>

**Level of Correlation between PO's and PSO's**

*(Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix)*

Assign the value

**1 – Low**

**2 – Medium**

**3 – High**

**0 – No Correlation**

**M. Sc., COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE****SEMESTER - I**

<b>Course status</b>	<b>Course Title</b>	<b>Credits</b>	<b>Hours</b>
Core	Artificial Intelligence & Expert Systems	4	6
Core	Fundamentals of Data Science	4	6
Elective - I	Mathematics for Data Science/ Design & Analysis of Algorithms	3	4
Elective - II	Compiler Design / Virtual and Augmented Reality	3	4
Practical	Algorithm Lab	3	5
Practical	Python Programming Lab	3	5
	<b>Total</b>	<b>20</b>	<b>30</b>

**SEMESTER - II**

<b>Course status</b>	<b>Course Title</b>	<b>Credits</b>	<b>Hours</b>
Core	Machine Learning	4	5
Core	Big Data Analytics	4	5
Elective 3	Pattern Recognition & Image Analysis / Optimization Techniques	3	4
Elective 4	Wireless Networks & Mobile Computing/ Databases for Data Science	3	4
Practical	Machine Learning Lab	3	4
Practical	Big Data Analytics Lab	3	4
Skill Enhancement Course [SEC]	Social Network Analysis	2	4
	Total	22	30

## Semester –I

L	T	P	C
5	1	0	6

### ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS

#### *Course Objectives:*

1. To understand the basic concepts and principles of Artificial Intelligence
2. To learn various applications domains of AI
3. To study the concepts of Expert Systems

#### **Unit-I Fundamentals of Artificial Intelligence**

Introduction: What is AI? AI Techniques, Representation of Knowledge, Knowledge Based Systems, State Space Search. Production Systems: Problem Characteristics, Types of production systems. Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation, Knowledge based agents

#### **Unit-II Search Strategies**

Informed Search: Generate & test, Hill Climbing, Best First Search, A\* and AO\* Algorithm, Constraint satisfaction, Means-Ends Analysis. Game playing: Minimax Search, Alpha-Beta Cutoffs, Waiting for Quiescence

#### **Unit-III Knowledge Representation**

Propositional Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining. First order Logic: Representation, Inference, Reasoning Patterns, Resolution, Forward and Backward Chaining.

#### **Unit-IV Expert systems**

Architecture of expert systems, Steps to build Expert Systems - Role of expert systems - Knowledge Acquisition - Meta knowledge, Heuristics. Typical expert systems - MYCIN, PROSPECTOR

#### **Unit-V Prolog Programming**

Introduction to Prolog: Syntax and Numeric Function, Basic List Manipulation Functions in Prolog, Functions, Predicates and Conditional, Input, Output and Local Variables, Iteration and Recursion, Property Lists and Arrays

#### *Course Outcome:*

On successful completion of the course, the learners will be able to

1. Delineate Artificial intelligence.
2. Build knowledge based systems.
3. Understand the basics of knowledge representations
4. Develop Expert Systems
5. Reformulate a problem from AI perspective

### CO-PO, PSO Mapping

ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS											
CO	PO					PSO					COGNITIVE LEVEL
	1	2	3	4	5	1	2	3	4	5	
CO1	S	S	S	M	S	S	S	M	S	S	K-1
CO2	S	S	M	S	S	S	S	S	S	S	K-4
CO3	S	S	M	S	S	S	S	S	S	S	K-2
CO4	S	S	M	S	S	S	S	S	S	S	K-3
CO5	S	S	M	S	S	S	S	S	S	S	K-6

**Strongly Correlated–S, Moderately Correlated–M, Weekly Correlated-L**

**Text Books:**

1. Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence." Tata McGraw Hill, 3<sup>rd</sup> Edition
2. Stuart Russell & Peter Norvig, "Artificial Intelligence : A Modern Approach", Pearson Education, 2<sup>nd</sup> Edition.
3. Donald A. Waterman, "A Guide to Expert Systems", Addison Wesley Publishing Company
4. Carl Townsend, "Introduction to Prolog Programming"
5. Ivan Bratko, "PROLOG Programming for Artificial Intelligence", Addison-Wesley, 2<sup>nd</sup> Edition.
6. Klocksinn and Mellish, "Programming with PROLOG"

**Reference Books:**

1. Eugene, Charniak, Drew McDermott, "Introduction to Artificial Intelligence", Addison Wesley
2. Patterson, "Introduction to AI and Expert Systems", PHI
3. Nilsson, "Principles of Artificial Intelligence", Morgan Kaufmann.
4. Carl Townsend, "Introduction to Turbo Prolog", Paperback

<https://nptel.ac.in/courses/106/105/106105077/>

<https://lecturenotes.in/materials/29314-note-for-artificial-intelligence-ai-by-jaswanth-chowdary>  
[https://www.tutorialspoint.com/artificial\\_intelligence/index.htm](https://www.tutorialspoint.com/artificial_intelligence/index.htm)

**MSU / 2023-24 / PG – Colleges / M.Sc. CS with AI**

<b>Title of the Course</b>		<b>FUNDAMENTALS OF DATA SCIENCE</b>					
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	I				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		5	1	--	6		
<b>Pre-requisite</b>		Basic understanding of data and process					
<b>Objectives of the Course</b>		To introduce the concepts and fundamentals of data science and its life cycle					
<b>Learning Outcome</b>		<p>Students will be able to</p> <p><b>CO1 :</b> Understand the types of data and analytics , data science process, and its life cycle.</p> <p><b>CO 2:</b> Apply math in data science</p> <p><b>CO 3:</b> Analyze the various data intensive operations and tools</p> <p><b>CO 4:</b> Evaluate the tools and methods for analyzing the data</p> <p><b>CO 5:</b> Investigate the recent potential applications and development of data science with real time case studies</p>					
<b>Course Outline</b>		<b>UNIT-I : INTRODUCTION OF DATA SCIENCE</b> Data Science – Data science Venn diagram - Basic terminology – Data science case studies- Types of data – levels of data- Types of data analytics - Descriptive analytics-Diagnostic analytics- Predictive analytics- Prescriptive analytics- Five steps of Data science <b>Book 1 - Chapter 1,2,3</b>					
		<b>UNIT-II : MATHEMATICAL PRELIMINARIES</b> 2.1 Basic Maths – mathematics as discipline – basic symbols and terminology –linear algebra 2.2 Basic Probability – definitions- probability – Bayesian vs frequentist – compound events – conditional probability – rules of probability <b>Book 1: Unit 2.1 – Chapter 4, Unit 2.2 – Chapter 5</b>					
		<b>UNIT-III : DATA MINING AND DATA WAREHOUSING</b> Introduction to Data warehousing – Design consideration of data warehouse - Data loading process – case study – Data mining – Data mining techniques – Tools and platforms – case study <b>Book 2 – Chapter 3 and 4</b>					
		<b>UNIT-IV : VISUALIZING DATA</b> Exploratory Data Analysis – Developing the visual aesthetic – chart types – Great visualizations – Reading graphs – Interactive visualizations <b>Book 3 - Chapter 6</b>					

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	<b>UNIT-V: Data Science – Recent Trends</b> Applications of Data Science, recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.
Extended Professional Component	Case study on recent developments and presentation
Skills acquired from this course	Data Science Process, Fundamentals, Applications
<b>Recommended Text</b>	<ol style="list-style-type: none"> <li>Ozdemir, Sinan. Principles of data science. Packt Publishing Ltd, 2016.(Unit 1- Chapter 1,2,3 Unit 2.1 – Chapter 4, Unit 2.2 – Chapter 5 )</li> <li>Maheshwari, Anil. "Data analytics made accessible." Seattle: Amazon Digital Services, 2 nd edition (2023).(Unit 3 – Chapter 3 and 4)</li> <li>Skiena, Steven S. The data science design manual. Springer, 2017.(Unit 4- chapter 6)</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>Hadrien Jean.Education, C. (2023). Data Science. Certybox Education.</li> <li>Pierson, Lillian. Data science for dummies. John Wiley &amp; Sons, 2021.</li> <li>Grus, Joel. Data science from scratch: first principles with python. O'Reilly Media, 2019.</li> <li>Blum, Avrim, John Hopcroft, and Ravindran Kannan. Foundations of data science. Cambridge University Press, 2020.</li> </ol>
<b>Website and e-Learning Source</b>	<a href="https://www.analyticsvidhya.com/">https://www.analyticsvidhya.com/</a> <a href="https://www.simplilearn.com">https://www.simplilearn.com</a> <a href="https://www.ibm.com/in-en/topics/data-science">https://www.ibm.com/in-en/topics/data-science</a> <a href="https://www.mygreatlearning.com/blog/what-is-data-science/">https://www.mygreatlearning.com/blog/what-is-data-science/</a>

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	3	3	2
CO2	3	2	2	3	3	2
CO3	3	2	3	3	3	3
CO4	3	2	3	3	3	3
CO5	3	2	2	3	3	3
<b>Weightage of course contributed to each PSO</b>	<b>15</b>	<b>10</b>	<b>12</b>	<b>15</b>	<b>15</b>	<b>13</b>

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<b>Title of the Course</b>		<b>MATHEMATICS FOR DATA SCIENCE</b>					
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	I				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		4		--	4		
<b>Pre-requisite</b>		UG level Mathematics					
<b>Objectives of the Course</b>		To build the mathematical background necessary to understand and implement in data science practical/research work					
<b>Learning Outcome</b>		<p>Students will be able to</p> <p><b>CO1:</b> Demonstrate understanding of basic mathematical concepts in data science, relating to linear algebra</p> <p><b>CO2:</b> Describe properties of linear systems using vectors, perform and interpret matrix operations.</p> <p><b>CO3:</b> Describe and compute orthogonality and determinants</p> <p><b>CO4:</b> Solve linear differential equations</p> <p><b>CO5:</b> Understand and apply the concept of Linear transformations</p>					
<b>Course Outline</b>		<p><b>UNIT-I:</b></p> <p><b>1.1 Vectors and Matrices</b>            Vectors and Linear Combinations-Lengths and Angles from Dot Products-Matrices and Their Column Spaces-Matrix Multiplication AB and CR</p> <p><b>1.2 Solving Linear Equations <math>Ax = b</math></b>            Elimination and Back Substitution-Elimination Matrices and Inverse Matrices-Matrix Computations and <math>A = LU</math>-Permutations and Transposes</p>					
		<p><b>UNIT-II:</b></p> <p><b>2.2 The Four Fundamental Subspaces</b>            Vector Spaces and Subspaces-Computing the Nullspace by Elimination: <math>A = CR</math>-The Complete Solution to <math>Ax = b</math>-Independence, Basis, and Dimension-Dimensions of the Four Subspaces</p>					
		<p><b>UNIT-III:</b></p> <p><b>3.1 Orthogonality</b>            Orthogonality of Vectors and Subspaces-Projections onto Lines and Subspaces-Least Squares Approximations-Orthonormal Bases and Gram-Schmidt-The Pseudoinverse of a Matrix</p> <p><b>3.2 Determinants</b>            3 by 3 Determinants and Cofactors-Computing and Using Determinants-Areas and Volumes by Determinants</p>					
		<p><b>UNIT-IV :</b></p> <p><b>4.1 Eigenvalues and Eigenvectors</b>            Introduction to Eigenvalues : <math>Ax = \lambda x</math> - Diagonalizing a Matrix-Symmetric Positive Definite Matrices-Complex Numbers and Vectors and Matrices-Solving Linear Differential Equations</p>					
		<p><b>UNIT-V:</b></p> <p><b>5.1 The Singular Value Decomposition (SVD)</b>            Singular Values and Singular Vectors-Image Processing by Linear Algebra-Principal Component Analysis (PCA by the SVD)</p> <p><b>5.2 Linear Transformations</b>            The Idea of a Linear Transformation-The Matrix of a Linear Transformation-The Search for a Good Basis</p>					

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Extended Professional Component	Problems related to the above topics to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency
<b>Recommended Text</b>	[1] Gilbert Strang, Introduction to Linear Algebra, Wellesley - Cambridge Press, Sixth Edition, 2023
<b>Reference Books</b>	[1] David Lay, Steven Lay, Judi McDonald, Linear Algebra and Its Applications 5th Edition, Pearsons [2] Sheldon Axler, Linear Algebra Done Right (Undergraduate Texts in Mathematics) 3rd ed., Springer, 2015 Edition [3] Jim Hefferon, Linear Algebra, Fourth edition [4] Jeff M Philips, Mathematical Foundations for Data Analysis
<b>Website and e-Learning Source</b>	<a href="https://joshua.smcvt.edu/linearalgebra/">https://joshua.smcvt.edu/linearalgebra/</a>

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	3	3	3
CO2	3	3	2	3	3	3
CO3	3	2	3	3	3	3
CO4	3	3	2	3	3	3
CO5	3	3	2	3	3	3
<b>Weightage of course contributed to each PSO</b>	<b>15</b>	<b>13</b>	<b>11</b>	<b>15</b>	<b>15</b>	<b>15</b>



	L	T	P	C
DESIGN AND ANALYSIS OF ALGORITHMS	4	0	0	3

**Course Objective:**

To learn effective problem solving in computing applications and analyze the algorithmic procedure to determine the computational complexity

**Unit I: Introduction:** Algorithm Definition – Algorithm Specification – Performance Analysis- Asymptotic Notations. Elementary Data Structures: Stacks and Queues – Trees – Dictionaries – Priority Queues – Sets and Disjoint Set Union – Graphs

**Unit II: Divide and Conquer:** The General Method – Defective Chessboard – Binary Search – Finding the Maximum and Minimum – Merge Sort – Quick Sort – Selection - Strassen’s Matrix Multiplication.

**Unit III: The Greedy Method:** General Method - Container Loading - Knapsack Problem - Tree Vertex Splitting – Job Sequencing With Deadlines - Minimum Cost Spanning Trees - Optimal Storage On Tapes – Optimal Merge Patterns - Single Source Shortest Paths.

**Unit IV: Dynamic Programming:** The General Method – Multistage Graphs – All-Pairs Shortest Paths – Single-Source Shortest Paths - Optimal Binary Search Trees - String Editing - 0/1 Knapsack - Reliability Design - The Traveling Salesperson Problem - Flow Shop Scheduling. Basic Traversal and Search Techniques: Techniques for Binary Trees – Techniques for Graphs – Connected Components and Spanning Trees – Bi-connected Components and DFS.

**Unit V: Backtracking:** The General Method – The 8-Queens Problem – Sum of Subsets – Graph Coloring – Hamiltonian Cycles – Knapsack Problem Branch and Bound: Least Cost search - 0/1 Knapsack Problem.

**Course Outcome:**

On successful completion of the course, the learners will be able to

1. Understand and solve complex problems
2. Select an appropriate algorithm for the problem
3. Evolve as a competent programmer capable of designing and analyzing algorithms and data structures for different kinds of problems
4. Classify problems into complexity classes like P and NP.
5. Analyze graphs and determine shortest path

DESIGN AND ANALYSIS OF ALGORITHMS											
CO	PO					PSO					COGNITIVE LEVEL
	1	2	3	4	5	1	2	3	4	5	
CO 1	M	H	H	M	H	H	H	M	H	H	K – 2
CO 2	H	M	M	H	H	H	H	H	H	H	K – 1
CO 3	H	H	M	H	H	H	H	H	H	H	K – 3
CO 4	H	H	M	H	H	H	H	H	H	H	K – 4
CO 5	H	H	M	H	M	H	H	H	H	H	K – 6

**Text Book**

1. Ellis Horowitz, Satraj Sahni and Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, Universities Press, Second Edition, Reprint 2009.

**References**

1. Data Structures Using C - Langsam, Augenstien, Tenenbaum, PHI
2. Data structures and Algorithms, V.Aho, Hopcroft, Ullman , LPE
3. Introduction to design and Analysis of Algorithms - S.E. Goodman, ST. Hedetniem- TMH.
4. Carlos A.Coello Coello, Gary B.Lamont, David A.Van Veldhuizen, "Evolutionary Algorithms for Solving Multi-Objective Problems", Springer 2nd Edition, 2007.

<b>Title of the Course</b>		<b>COMPILER DESIGN</b>					
<b>Paper Number</b>		<b>ELECTIVE I (EC1)</b>					
<b>Category</b>	Elective	<b>Year</b>	I	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	I				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		4		-	4		
<b>Pre-requisite</b>		Basic knowledge in one of the programming language and data structures					
<b>Objectives of the Course</b>		To acquire the knowledge about the compiler design and to understand the different phases of Compiler					
<b>Course Outline</b>		<p><b>UNIT-I</b> : Compilers &amp; Translators, Need of Translators, Structure of a Compiler, Phases, Lexical Analysis, Syntax Analysis, Intermediate Code Generation, Code Optimization, Code Generation, Book Keeping, A Symbol Table in brief, Semantic Analysis, L-value, r-values, Error Handling</p>					
		<p><b>UNIT-II</b> : Rules of Lexical Analyser, Need for Lexical Analysis, Input Buffering, Preliminary Scanning, A simple Approach to the Design of Lexical Analysers, Transition Diagrams, Regular Expression, String &amp; Languages, Finite Automata, Non-deterministic Automata, Deterministic Automata, From regular Expression to Finite Automata, Context free Grammars, Derivations &amp; Parse Trees, Parsers, Shift Reduce Parsing, Operator-Precedence Parsing</p>					

	<p><b>UNIT-III</b> : Symbol Table Management, Contents of a Symbol Table, Names &amp; Symbol table records, reusing of symbol table spaces, array names, Indirection in Symbol Table entries, Data Structures for Symbol Tables, List, Self Organizing Lists, Search Trees, Hash Tables, Errors, Reporting Errors, Sources of Errors Syntactic Errors, Semantic Errors, Dynamic Errors, Lexical Phase Errors, Minimum Distance Matching, Syntactic Phase Error, Time of Detection, Ponc mode, Case study on Lex and Yacc</p>
	<p><b>UNIT-IV</b> :Principal Sources of Optimization, Inner Loops, Language Implementation Details Inaccessible to the User. Further Optimization, Algorithm Optimization, Loop Optimization , Code Motion, Induction Variables, Reduction in Strength, Basic Blocks, Flow Graphs, DAG Representation of Basic Blocks, Value Numbers &amp; Algebraic Laws, Global Data Flow Analysis, Memory Management Strategies , Fetch Strategy, Placement Strategies, Replacement Strategies, Address Binding, Compile Time, Load Time, Execution Time, Static Loading, Dynamic Loading, Dynamic Linking</p>

	<b>UNIT-V:</b> Problems in Code Generation, a Simple Code Generator, Next-Use Information, Register Descriptors, Address Descriptors, Code Generation Algorithm, Register Allocation & Assignment, Global Register Allocation, Usage Counts, Register Assignment for Outer Loops, Register Allocation by Graph Coloring, Code Generation from DAG's, Peep-Hole Optimization, Redundant Loads & Stores, Un-Reachable Code, Multiple Jumps, Algebraic Simplifications, Use of Machine Idioms
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Text</b>	Compilers: Principles, Techniques & Tools, Second Edition by A. V. Aho, Monicas. Lam, Ravi Sethi, J. D. Ullman
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Dhamdhare D.M., “Compiler Construction: Theory and Practice”, McMillan India Ltd., 1983</li> <li>2. Holub Allen, “Compiler Design in C”, Prentice Hall of India, 1990</li> </ol>
<b>Website and e-Learning Source</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.geeksforgeeks.org/compiler-design-tutorials/">https://www.geeksforgeeks.org/compiler-design-tutorials/</a></li> <li>2. <a href="https://www.tutorialspoint.com/compiler_design/">https://www.tutorialspoint.com/compiler_design/</a></li> <li>3. <a href="https://www.javatpoint.com/compiler-tutorial">https://www.javatpoint.com/compiler-tutorial</a></li> <li>4. <a href="https://onlinecourses.nptel.ac.in/noc19_cs01/prview">https://onlinecourses.nptel.ac.in/noc19_cs01/prview</a></li> <li>5. <a href="http://ecomputernotes.com/compiler-design">http://ecomputernotes.com/compiler-design</a></li> </ol>

**Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

<b>CO's</b>	<b>Course Outcomes</b>
<b>CLO1</b>	Identify the major phases of compilation and the functionality of LEX and YACC
<b>CLO2</b>	Describe the functionality of compilation process and symbol table management
<b>CLO3</b>	Apply the various parsing, optimization techniques and error recovery routines to have a better code for code generation
<b>CLO4</b>	Analyze the techniques and tools needed to design and implement compilers.
<b>CLO5</b>	Test a compiler and experiment the knowledge of different phases in compilation

<b>CO/PSO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	<b>PSO6</b>
<b>CLO1</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>2</b>
<b>CLO2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>
<b>CLO3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>
<b>CLO4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>
<b>CLO5</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Weightage of course contribute to each PSO</b>	<b>15</b>	<b>12</b>	<b>13</b>	<b>13</b>	<b>13</b>	<b>14</b>

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<b>Title of the Course</b>		<b>VIRTUAL AND AUGMENTED REALITY</b>					
<b>Paper Number</b>		<b>ELECTIVE</b>					
<b>Category</b>	Elective	<b>Year</b>	I	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	I				
<b>Instructional Hours per week</b>	<b>Lecture</b>	<b>Tutorial</b>		<b>Lab Practice</b>		<b>Total</b>	
	4			-		4	
<b>Pre-requisite</b>		Basic knowledge of computer graphics					
<b>Objectives of the Course</b>		To provide knowledge on basic principles of virtual & augmented reality and have the ability to use its technology as a platform for real-world applications.					
<b>Course Outline</b>		<p align="center"><b>UNIT-I :</b></p> <p><b>Virtual Reality:</b> The Three I's of VR – History – Early commercial VR Technology – Components of a VR System – <b>Input Devices:</b> Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces</p>					
		<p align="center"><b>UNIT-II :</b></p> <p><b>Output Devices:</b> Graphics Displays – Sound Displays – Haptic Feedback - <b>Computer Architecture for VR:</b> The Rendering Pipeline- PC Graphics Architecture - <b>VR Programming:</b> Toolkits and Scene Graphs – Traditional and Emerging Applications of VR</p>					
		<p align="center"><b>UNIT-III :</b></p> <p><b>Augmented Reality:</b> Introduction – <b>Augmented Reality Concepts:</b> Working Principle of AR –Concepts related to AR-Ingredients of an Augmented Reality Experience</p>					
		<p align="center"><b>UNIT-IV :</b></p> <p>Augmented Reality Hardware– Augmented Reality Software– Software to create content for AR Application – Tools and Technologies</p>					
		<p align="center"><b>UNIT-V:</b></p> <p><b>Augmented Reality Content:</b> Introduction- Creating Content for Visual, Audio, and other senses – Interaction in AR - <b>Mobile Augmented Reality:</b> Introduction – Augmented Reality Applications Areas- Collaborative Augmented Reality</p>					

**MSU / 2023-24 / PG – Colleges / M.Sc. CS with AI**

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Text</b>	<ol style="list-style-type: none"> <li>1. Grigore C. Burdea and Philippe Coiffet, “Virtual Reality Technology”, Wiley Student Edition , Second Edition (Unit I: Chapter 1,2 &amp; Unit II: Chapter 3,4,6,8 &amp; 9)</li> <li>2. Alan B. Craig(2013), “Understanding Augmented Reality: Concepts and Applications”(Unit III: Chapter 1, 2, Unit IV : Chapter 3, 4 &amp; Unit V: Chapter 5,6,8)</li> <li>3. Jon Peddie (2017), “Augmented Reality: Where We Will All Live”, Springer, Ist Edition (Unit IV: Chapter 7 (Tools &amp; Technologies)</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Alan Craig &amp; William R. Sherman &amp; Jeffrey D. Will, Morgan Kaufmann(2009), “Developing Virtual Reality Applications: Foundations of Effective Design”, Elsevier( Morgan Kaufmann Publishers)</li> <li>2. Paul Mealy (2018), “Virtual and Augmented Reality”,Wiley</li> <li>3. Bruno Arnaldi &amp; Pascal Guitton &amp; Guillaume Moreau(2018), “Virtual Reality and Augmented Reality: Myths and Realities”, Wiley</li> </ol>
<b>Website and e-Learning Source</b>	<ol style="list-style-type: none"> <li>1. Manivannan, M., (2018), “Virtual Reality Engineering,” IIT Madras, <a href="https://nptel.ac.in/courses/121106013">https:// nptel.ac.in/ courses/121106013</a></li> <li>2. Dube, A., (2020), “Augmented Reality - Fundamentals and Development,” NPTEL Special Lecture Series, <a href="https://www.youtube.com/watch?v=MGuSTaqlZ9Q">https:// www.youtube.com /watch?v=MGuSTaqlZ9Q</a></li> <li>3. <a href="http://msl.cs.uiuc.edu/vr/">http://msl.cs.uiuc.edu/vr/</a></li> <li>4. <a href="http://www.britannica.com/technology/virtual-reality/Living-in-virtual-worlds">http://www.britannica.com/technology/virtual-reality/Living-in-virtual-worlds</a></li> <li>5. <a href="https://mobidev.biz/blog/augmented-reality-development-guide">https://mobidev.biz/blog/augmented-reality-development-guide</a></li> </ol>



**Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

<b>CO's</b>	<b>Course Outcomes</b>
<b>CLO1</b>	Outline the basic terminologies, techniques and applications of VR and AR
<b>CLO2</b>	Describe different architectures and principles of VR and AR systems
<b>CLO3</b>	Use suitable hardware and software technologies for different varieties of virtual and augmented reality applications
<b>CLO4</b>	Analyze and explain the behavior of VR and AR technology relates to human perception and cognition
<b>CLO5</b>	Assess the importance of VR/AR content and interactions to implement for the real-world problem

<b>CO/PSO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	<b>PSO6</b>
<b>CLO1</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CLO2</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CLO3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CLO4</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>
<b>CLO5</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Weightage of course contribute to each PSO</b>	<b>15</b>	<b>9</b>	<b>10</b>	<b>13</b>	<b>13</b>	<b>12</b>

**ALGORITHM LAB**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>5</b>	<b>3</b>

**Prolog:**

1. Write Prolog program to implement A\* algorithm.
2. Write Prolog program to implement MinMax search
3. Write Prolog program to solve water jug problem
4. Write Prolog program to implement TicTacToe
5. Write Prolog program to implement alpha-beta pruning
6. Write Prolog program to solve 4 Queen problem

**C++**

1. Sort a given set of elements using the Quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n.
2. Write a program to obtain the topological ordering of vertices in a given digraph.
3. Implement travelling salesman problem.
4. Find minimum cost spanning tree of a given undirected path using a Prim’s algorithm.
5. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra’s algorithm.
6. Solve N queen problem

**CO - PO - PSO Mapping**

ALGORITHM LAB											
CO	PO					PSO					COGNITIVE LEVEL
	1	2	3	4	5	1	2	3	4	5	
CO 1	H	H	H	M	H	H	H	M	H	H	K - 1
CO 2	H	H	M	H	H	H	H	H	H	H	K - 4
CO 3	H	H	M	H	H	H	H	H	H	H	K - 5
CO 4	H	H	M	H	H	H	H	H	H	H	K - 3
CO 5	H	H	M	H	H	H	H	H	H	H	K - 5

**Strongly Correlated - H, Moderately Correlated - M, Weekly Correlated - L**

PYTHON PROGRAMMING LAB

L	T	P	C
0	0	5	3

1. Program using Strings - Program to Sort Words in Alphabetic Order
2. Program to perform various list operations, such as:
  - Insert an element (include appending also)
  - Search an element
  - Modify an existing element
  - Delete an existing element (position & Value)
  - Sort the list
3. Program using Tuples - swap two numbers without using a temporary variable.
4. Program using Dictionaries - count the number of times a character appears in a given string
5. Write a function to convert number into corresponding number in words  
For eg, if the input is 876 then the output should be 'Eight Seven Six'.
6. Program using Inheritance.
7. Program using Interfaces.
8. Program involving Overloading
9. Program using Regular Expressions.
10. Working with Widgets.
11. Program to Insert, Delete and Update in Database.
12. Program to create and perform operations using Data Frames.
13. Program to implement Data Visualization.
14. Reading and Writing Text Files and Binary Files
15. Combining and Merging Data Sets
16. Data Aggregation and GroupWise Operations

**Course Outcome:**

On successful completion of the course, the learners will be able to

1. Appreciate programming concepts in Python
2. Work with Widgets.
3. Insert, Delete and Update in Database.
4. Create and perform operations using Data Frames.

5. Implement Data Visualization

**CO - PO - PSO Mapping**

PYTHON PROGRAMMING LAB											
CO	PO					PSO					COGNITIVE LEVEL
	1	2	3	4	5	1	2	3	4	5	
CO 1	H	H	H	M	H	H	H	M	H	H	K - 2
CO 2	H	H	M	H	H	H	H	H	H	H	K - 3
CO 3	H	H	M	H	H	H	H	H	H	H	K - 2
CO 4	H	H	M	H	H	H	H	H	H	H	K - 6
CO 5	H	H	M	H	H	H	H	H	H	H	K - 5

Strongly Correlated - H, Moderately Correlated - M, Weekly Correlated - L

## Semester II

<b>Title of the Course</b>		<b>Machine Learning</b>					
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	II				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		4	1	--	5		
<b>Pre-requisite</b>		Basic Programming Skill and Data Knowledge					
<b>Objectives of the Course</b>		To understand the different types, steps and algorithms involved in Machine Learning Process					
<b>Learning Outcome</b>		<p><b>CO1:</b> Describe the data, essential steps for creating a typical ML model and the fundamentals of pattern classification</p> <p><b>CO2:</b> Able to examine different ML algorithms and unprocessed data and features</p> <p><b>CO3:</b> Implement the essential techniques to reduce the number of features in a dataset and test the performance of predictive models</p> <p><b>CO4:</b> Select multiple algorithms, combine and produce ensembles, discuss the essential techniques for modeling linear relations</p> <p><b>CO5:</b> Discuss the clustering algorithms, develop a Web application embedding a ML model</p>					
<b>Course Outline</b>		<p><b>UNIT-I : Data Analytics with pandas and NumPy</b> - NumPy and basic stats - Matrices - pandas library - Working with data - Null Values - Creating statistical graphs <b>Book 1, Chapter -10</b></p> <p><b>Giving Computers the ability to learn from data</b> - Introduction - Building intelligent systems to transform data into knowledge - The three different types of Machine Learning(ML) - Introduction to basic terminology and notations - A roadmap for building ML systems - Using Python for ML <b>Book 2, Chapter - 1</b></p> <p><b>Training Simple ML Algorithms for Classification</b> - Early History of ML - Implementing a Perceptron learning algorithm - Adaptive linear neurons and the convergence of learning <b>Book 2, Chapter – 2</b></p> <p><b>UNIT-II : ML Classifiers using scikit-learn</b> - Choosing a classification algorithm - Training a perceptron - Modeling class probabilities via logistic regression - Maximum margin classification with support vector machines(SVM) - Solving nonlinear problems using a kernel SVM - Decision tree learning - K-nearest neighbours: a lazy learning algorithm <b>Book 2 Chapter 3</b></p> <p><b>Data Preprocessing</b> - Missing data - Categorical data - Partitioning a dataset into separate training and test datasets - Bringing features onto the same scale - Selecting meaningful features - Assessing feature importance with random forests <b>Book 2 Chapter – 4</b></p>					

	<p><b>UNIT-III : Compressing Data via Dimensionality Reduction</b> - Unsupervised dimensionality reduction via principal component analysis - Supervised data compression via linear discriminant analysis - Using kernel principal component analysis for nonlinear mappings <b>Book 2, Chapter - 5</b></p> <p><b>Learning Best Practices for Model Evaluation and Hyperparameter Tuning</b>          - Streamlining workflows with pipelines - Using k-fold cross-validation to assess model performance - Debugging algorithms with learning and validation curves - Fine-tuning ML models via grid search - Looking at different performance evaluation metrics <b>Book 2, Chapter – 6</b></p> <p><b>UNIT-IV : Combining different models for ensemble learning</b> - Learning with ensembles - Combining classifiers via majority vote - Bagging: building an ensemble of classifiers from bootstrap samples - Leveraging weak learners via adaptive boosting <b>Book 2, Chapter - 7</b></p> <p><b>Predicting Continuous Target Variables with Regression Analysis - Introducing Linear regression</b> - Implementing an ordinary least squares linear regression model - Fitting a robust regression model using RANSAC - Evaluating the performance of linear regression models - Using regularised methods for regression - Turning a linear regression model into a curve - polynomial regression - Dealing with nonlinear relationships using random forests <b>Book 2, Chapter – 10</b></p> <p><b>UNIT-V: Working with Unlabelled Data</b> – Grouping objects by similarity using k-means - Organising clusters as a hierarchical tree - Locating regions of high density via DBSCAN <b>Book 2, Chapter - 11</b></p> <p><b>Introduction to Embedding a ML model into a Web Application</b> - Serialising fitted scikit-learn estimators - Setting up an SQLite database for data storage - Developing a web application with Flask - Turning any classifier into a web application - Deploying the web application to a public server <b>Book 2, Chapter – 9</b></p>
Extended Professional Component	Mini project applying ML concepts in existing / real time data(is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired from this course	Preprocessing, ML steps, Prediction and Performance evaluation , Embedding ML model into a web application
<b>Recommended Text</b>	<ol style="list-style-type: none"> <li>1. Corey Wade et al, Vahid Mirjalili, The Python Workshop, 2nd Edition, packs publishing, 2022</li> <li>2. Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, 3rd Edition, packt publishing, 2019</li> </ol>

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<b>Reference Books</b>	<ol style="list-style-type: none"><li>1. Andreas C. Mueller, Sarah Guido. Introduction to Machine Learning with Python. O'Reilly Media, Inc., 2016.</li><li>2. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, <a href="http://mitpress.mit.edu/catalog/item/default.asp?type=2&amp;tid=12012">http://mitpress.mit.edu/catalog/item/default.asp?type=2&amp;tid=12012</a>, 2010</li><li>3. Wes McKinney. Python for Data Analysis. O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, second edition, 2018</li></ol>
<b>Website and e-Learning Source</b>	<ol style="list-style-type: none"><li>1. <a href="https://data-flair.training/blogs/machine-learning-tutorial/">https://data-flair.training/blogs/machine-learning-tutorial/</a></li><li>2. <a href="https://www.geeksforgeeks.org/machine-learning/">https://www.geeksforgeeks.org/machine-learning/</a></li></ol>

**Course Outcome**

Upon completion of the course, the student will be able to

<b>CO/ PSO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	<b>PSO6</b>
<b>CO1</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>CO2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>2</b>
<b>CO3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>
<b>CO4</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>
<b>CO5</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Weightage of course contributed to eachPSO</b>	<b>15</b>	<b>13</b>	<b>13</b>	<b>12</b>	<b>14</b>	<b>13</b>

**MSU / 2023-24 / PG – Colleges / M.Sc. CS with AI**

<b>Title of the Course</b>		<b>BIG DATA ANALYTICS</b>					
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	II				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		4	1	--	5		
<b>Pre-requisite</b>		Basic understanding of programming and logical thinking					
<b>Objectives of the Course</b>		To introduce the concepts of big data analytics and developing a real time applications					
<b>Learning Outcome</b>		<p>Students will be able to</p> <p><b>CO 1:</b> Understand the basic concepts of big data analytics and technologies</p> <p><b>CO 2:</b> Apply the concept of HDFS, Map reduce for storing and processing of Big data</p> <p><b>CO 3:</b> Analyze and perform different operations on data using Pig, Hive, and Hbase</p> <p><b>CO 4:</b> Evaluate tools and methods for analyzing Big data analytics model</p> <p><b>CO 5:</b> Develop real time big data analytics applications</p>					
<b>Course Outline</b>		<p><b>UNIT-I : INTRODUCTION TO BIG DATA ANALYTICS</b>            Classification of Digital Data, Structured and Unstructured Data - Introduction to Big Data: Characteristics – Evolution – Definition - Challenges with Big Data - Other Characteristics of Data - Why Big Data - Traditional Business Intelligence versus Big Data - Data Warehouse and Hadoop Environment Big Data Analytics: Classification of Analytics – Challenges - Big Data Analytics important - Data Science - Data Scientist - Terminologies used in Big Data Environments. <b>Book 1 - Chapter 1,2,3</b></p> <p><b>UNIT-II : BIG DATA TECHNOLOGY LANDSCAPE</b>            NoSQL, Comparison of SQL and NoSQL, Hadoop -RDBMS Versus Hadoop - Distributed Computing Challenges – Hadoop Overview - Hadoop Distributed File System - Processing Data with Hadoop - Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystem <b>Book 1: Chapter 4, 5</b></p> <p><b>UNIT-III : HADOOP AND HDFS</b>            Introduction to Hadoop – RDBMS vs Hadoop- distributed computing challenges - A Brief History of Hadoop- The Hadoop Distributed Filesystem- Processing Data with Hadoop - Anatomy of a MapReduce Works - Anatomy of a MapReduce Job Run- Job Scheduling- Shuffle and Sort- Task Execution <b>Book 2 – Chapter 1, 3,6</b></p>					



	<p><b>UNIT-IV : HADOOP ECO SYSTEM</b>                  Hive: Introduction – Architecture - Data Types - File Formats - Hive Query Language Statements – Partitions – Bucketing – Views - Sub-Query – Joins – Aggregations - Group by and Having - RCFile Implementation - Hive User Defined Function - Serialization and Deserialization. Pig: Introduction - Anatomy – Features – Philosophy - Use Case for Pig - Pig Latin Overview - Pig Primitive Data Types - Running Pig - Execution Modes of Pig - HDFS Commands - Relational Operators - Eval Function - Complex Data Types - Piggy Bank - User-Defined Functions - Parameter Substitution - Diagnostic Operator - Word Count Example using Pig - Pig at Yahoo! - Pig Versus Hive Hbase - HBasics, Concepts. <b>Book 1 - Chapter 9, 10 Book 2 - Chapter 11, 12,13</b></p> <p><b>UNIT-V: Case Studies</b> Hadoop Usage at Last.fm - Hadoop and Hive at Facebook- Nutch Search Engine- Log Processing at Rackspace – Cascading - TeraByte Sort on Apache Hadoop 601 - Using Pig and Wukong to Explore Billion-edge Network Graphs - Recent Trends in Big Data Analytics <b>Book 2 - Chapter 16</b></p>
Extended Professional Component	Case study on recent developments and presentation (is a part of internal component only, Not to be included in the External Examination question paper)
Skills acquired	Developing application using big data analytic techniques
<b>Recommended Text</b>	1. Big Data and Analytics, Seema Acharya, Subhashini Chellappan, First Edition, 2015, Wiley. 2. Tom White, Hadoop: The Definitive Guide, O’Reilly Media Inc., 2015.
Reference Books	1. Lublinsky, Boris, Kevin T. Smith, and Alexey Yakubovich. Professional hadoop solutions. John Wiley & Sons, 2013. 2. Big Data Analytics, RadhaShankarmani, M Vijayalakshmi, Second Edition, 2017, Wiley 3. Hadoop Essentials: A Quantitative Approach, Henry H. Liu, First Edition, 2012, PerfMath Publishers
<b>Website and e-Learning Source</b>	<a href="https://www.ibm.com/analytics/big-data-analytics">https://www.ibm.com/analytics/big-data-analytics</a> <a href="https://www.simplilearn.com/what-is-big-data-analytics-article">https://www.simplilearn.com/what-is-big-data-analytics-article</a> <a href="https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-big-data-analytics">https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-big-data-analytics</a>

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
<b>CO1</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CO2</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CO3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CO4</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>CO5</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Weightage of course contributed to each PO/PSO</b>	<b>15</b>	<b>15</b>	<b>10</b>	<b>15</b>	<b>15</b>	<b>15</b>

	L	T	P	C
PATTERN RECOGNITION AND IMAGE ANALYSIS	4	1	0	3

**Course Objective:**

To be familiar with processing of images, recognition of the pattern and their applications

**Unit I:** Introduction to Image Processing: Image formation, image geometry perspective and other transformation, stereo imaging elements of visual perception. Digital Image- sampling and quantization serial & parallel Image processing.

**Unit II:** Image Restoration: Constrained and unconstrained restoration Wiener filter , motion blur remover, geometric and radiometric correction Image data compression-Huffman and other codes transform compression, predictive compression two tone image compression, block coding, run length coding, and contour coding.

**Unit III:** Segmentation Techniques-thresh holding approaches, region growing, relaxation, line and edge detection approaches, edge linking, supervised and unsupervised classification techniques, remotely sensed image analysis and applications, Shape Analysis - Gestalt principles, shape number, moment Fourier and other shape descriptors, Skelton detection, Hough transform, topological and texture analysis, shape matching.

**Unit IV:** Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations - Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi square test.

**Unit V:** Statistical Pattern Recognition -Bayesian Decision Theory, Classifiers, Normal density and discriminant functions, Parameter estimation methods: Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM),Gaussian mixture models.

**Course Outcome:**

On successful completion of the course, the learners will be able to

1. Get acquainted with image processing
2. Apply basic algorithms in image processing
3. Grasp basics of knowledge representation
4. Analyze the texture of images
5. Recognize patterns

**CO - PO - PSO MAPPING**

<b>PATTERN RECOGNITION AND IMAGE ANALYSIS</b>											
<b>CO</b>	<b>PO</b>					<b>PSO</b>					<b>COGNITIVE LEVEL</b>
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	
<b>CO 1</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>H</b>	<b>H</b>	<b>K - 1</b>
<b>CO 2</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>K - 2</b>
<b>CO 3</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>K - 3</b>
<b>CO 4</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>K - 4</b>
<b>CO 5</b>	<b>H</b>	<b>H</b>	<b>M</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>K - 5</b>

**Strongly Correlated - H, Moderately Correlated - M, Weekly Correlated - L**

**TEXT BOOKS**

1. Digital Image Processing - Gonzalez and Wood, Addison Wesley, 1993.
2. Fundamental of Image Processing - Anil K. Jain, Prentice Hall of India.
3. Pattern Classification - R.O. Duda, P.E. Hart and D.G. Stork, Second Edition John Wiley, 2006

**REFERENCE BOOKS**

1. Digital Picture Processing - Rosenfeld and Kak, vol.I & vol.II, Academic,1982
2. Computer Vision - Ballard and Brown, Prentice Hall, 1982
3. An Introduction to Digital Image Processing - Wayne Niblack, Prentice Hall, 1986
4. Pattern Recognition and Machine Learning - C. M. Bishop, Springer, 2009.
5. Pattern Recognition - S. Theodoridis and K. Koutroumbas, 4th Edition, Academic Press,2009

**OPTIMIZATION TECHNIQUES**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Objective**

- To understand the concept of optimization
- To develop mathematical model of real life cases
- To study Optimization algorithms

Unit – I: Linear Programming Problem (LPP): Formulations and graphical solution of (2 variables) canonical and standard terms of linear programming problem. Simplex method, Two phase simplex

Unit – II: Duality in LPP- dual problem to primal- primal to dual problem-dual simplex method- Revised simplex method-Integer programming problem

Unit – III: Transportation Model: North West corner Method, Least cost method, and Vogel’s Approximation Method. Determining Net evaluation-Degeneracy in TP  
Assignment Model: Hungarian assignment model – Travelling salesman problem.

Unit – IV: Replacement Problem: Replacement policy for equipment that deteriorate gradually, Replacement of item that fail suddenly-Individual and group replacement, Problems in mortality and staffing.

Unit – V: Project Scheduling PERT/CPM Networks – Fulkerson’s Rule – Measure of Activity – PERT Computation – CPM Computation – Resource Scheduling.

**CO - PO - PSO Mapping**

OPTIMIZATION TECHNIQUES											
CO	PO					PSO					COGNITIVE LEVEL
	1	2	3	4	5	1	2	3	4	5	
CO 1	H	H	H	M	H	H	H	M	H	H	K - 1
CO 2	H	H	M	H	H	H	H	H	H	H	K - 4
CO 3	H	H	M	H	H	H	H	H	H	H	K - 5
CO 4	H	H	M	H	H	H	H	H	H	H	K - 3
CO 5	H	H	M	H	H	H	H	H	H	H	K - 5

**Strongly Correlated – H, Moderately Correlated – M, Weekly Correlated – L**

**Textbooks**

1. KantiSwarup, P.K. Gupta & Manmohan, “Operations Research”, Sultan Chand & Sons. 1996.
2. S.Kalavathy, “Operations Research”, Second Edition – Vikas Publishing House Pvt.Ltd.,

**References**

1. P. K. Gupta & Manmohan. Problems in Operations Research: Methods and Solutions Sultan Chand & Sons

Title of the Course		Wireless Networks and Mobile Computing					
Category	Core	Year	I	Credits	3	Course Code	
		Semester	II				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	4				--	4	
Objectives of the Course		<p>Students will try to learn:</p> <ul style="list-style-type: none"> <li>➤ Define the fundamentals of wireless networks. Summarize about Learning and analyzing the different wireless technologies.</li> <li>➤ Interpret the process of building and mobile networks applications.</li> <li>➤ Understand and evaluate emerging wireless technologies and computing environments</li> <li>➤ Critically assess the design considerations for wireless networks and J2ME</li> <li>➤ Conceive the security threats and related security standards on Wireless computing</li> </ul>					
Course Outline		<p><b>UNIT-I :</b>  <b>Mobile Computing Architecture:</b> Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Wireless Networks : Global Systems for Mobile Communication ( GSM and Short Service Messages (SMS): GSM Architecture, Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Introduction to SMS, SMS Architecture, SM MT, SM MO, SMS as Information bearer, applications, GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Billing and Charging in GPRS, Spread Spectrum technology, IS-95, CDMA versus GSM, Wireless Data, Third Generation Networks, Applications on 3G, Introduction to WiMAX</p>					

	<p><b>UNIT-II :</b> Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices. Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6</p> <p><b>UNIT-III :</b> <b>Mobile OS and Computing Environment :</b>Smart Client Architecture, The Client: User Interface, Data Storage, Performance, Data Synchronization, Messaging. The Server: Data Synchronization, Enterprise Data Source, Messaging. Mobile Operating Systems: WinCE, Palm OS, Symbian OS, Linux, Proprietary OS Client Development: The development process, Need analysis phase, Design phase, Implementation and Testing phase, Deployment phase, Development Tools, Device Emulators</p> <p><b>UNIT-IV :</b> <b>Building, Mobile Internet Applications :</b> Thin client: Architecture, the client, Middleware, messaging Servers, Processing a Wireless request, Wireless Applications Protocol (WAP) Overview, Wireless Languages: Markup Languages, HDML, WML, HTML, cHTML, XHTML, VoiceXML</p> <p><b>UNIT-V:</b> <b>J2ME:</b>Introduction, CDC, CLDC, MIDP; Programming for CLDC, MIDlet model, Provisioning, MIDlet life-cycle, Creating new application, MIDlet event handling, GUI in MIDP, Low level GUI Components, Multimedia APIs; Communication in MIDP, Security Considerations in MIDP</p>
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Text</b>	1. Ashok Talukder, RoopaYavagal, Hasan Ahmed: Mobile Computing, Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010.

<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Martyn Mallik: Mobile and Wireless Design Essentials, Wiley India, 2003</li> <li>2. Raj kamal: Mobile Computing, Oxford University Press, 2007.</li> <li>3. ItiSahaMisra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009.</li> </ol>
<b>Website and e-Learning Source</b>	<p> <a href="https://nptel.ac.in/courses/108/106/106106167/">https://nptel.ac.in/courses/108/106/106106167/</a>  <a href="https://nptel.ac.in/courses/117/104/117104099/">https://nptel.ac.in/courses/117/104/117104099/</a>  <a href="https://nptel.ac.in/courses/106/106/106106147/">https://nptel.ac.in/courses/106/106/106106147/</a> </p>

Students will able to:

**CLO1:** Explain the basic concepts of wireless network and wireless generations

**CLO 2:** Demonstrate the different wireless technologies such as CDMA, GSM, GPRS etc

**CLO 3:** Appraise the importance of mobile computing networks and mobile client IP- Protocols

**CLO 4:** Explain the design considerations for deploying the wireless network infrastructure

**CLO 5:** Differentiate and support the security measures, standards. Services and layer wise security considerations

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	2	2	3	3
CO2	2	3	2	2	3	3
CO3	2	3	2	2	3	3
CO4	3	3	2	2	3	3
CO5	3	3	2	2	3	3
<b>Weightage of course contributed to each PSO</b>	<b>12</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>15</b>	<b>15</b>

<b>Title of the Course</b>		<b>Databases for Data Science</b>					
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	II				
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		4		--			4
<b>Pre-requisite</b>		Fundamental computer knowledge including computer storage and hardware					
<b>Objectives of the Course</b>		To provide fundamentals of database design, modeling systems, data storage, world of data warehousing and NoSQL					
<b>Learning Outcome</b>		<p>Students will be able to</p> <p><b>CO1:</b> Understand and discuss the importance of relational data modeling and conceptual modelling</p> <p><b>CO2:</b> Experiment with various database and compose effective queries</p> <p><b>CO3:</b> Analyse the process of OLAP system construction</p> <p><b>CO4:</b> Evaluate the use of NOSQL and its approach to the database</p> <p><b>CO5:</b> Develop applications using Relational and NoSQL databases</p>					
<b>Course Outline</b>		<p><b>Unit 1: 1.1 Fundamental Concepts of Database Management</b>          Applications of Database Technology - Key Definitions - File versus Database Approach to Data Management - Elements of a Database System - Advantages of Database Systems and Database Management - Architecture and Categorization of DBMSs</p> <p><b>1.2 Conceptual Data Modeling using the ER Model and UML Class Diagram</b>          Phases of Database Design - The Entity Relationship Model - UML Class Diagram</p>					
		<p><b>Unit 2: 2.1 Types of Database Systems</b> Legacy Databases - Relational Databases: The Relational Model - Normalization</p> <p><b>2.2 Relational Databases</b> Structured Query Language - SQL Data Definition Language - SQL Data Manipulation Language</p>					



	<p><b>Unit 3: 3.1 Data Warehousing and Business Intelligence</b>  Operational versus Tactical/Strategic Decision-Making - Data Warehouse Definition - Data Warehouse Schemas - The Extraction, Transformation, and Loading (ETL) Process - Data Marts - Virtual Data Warehouses and Virtual Data Marts - Operational Data Store - Data Warehouses vs Data Lakes - Business Intelligence</p> <p><b>3.2 Introduction of NO SQL</b>  Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points Comparison of relational databases to new NoSQL stores, Mongo DB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column-Family Stores, AggregateOriented Databases. sharding, MapReduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer replication, Combining Sharding and Replication.</p>
	<p><b>Unit 4 4.2 Key Value Data Stores</b>  NoSQL Key/Value databases using MongoDB, Document Databases, Document oriented Database Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.</p>
	<p><b>Unit 5: 5.1 Document Oriented Database</b>  Column- oriented NoSQL databases using Apache HBASE, Column-oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage.</p> <p><b>5.2 Data Modeling with Graph</b>  Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm- Web as a graph, Page RankMarkov chain, page rank computation, Topic specific page rank Page Ranking Computation techniques iterative processing, Random walk distribution Querying Graphs</p>
<p>Extended Professional Component</p>	<p>Case studies to understand the limitations of Relational DBMS and the need for NoSQL database  Mini project - create a data store and process the data</p>

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Skills acquired from this course	Database designer, Data owner of different types of data, Data Scientist fluent in data, Business Professional
<b>Recommended Text</b>	Lemahieu, W., Broucke, S.vanden and Baesens, B. (2018) Principles of database management: The Practical Guide to storing, managing and analyzing big and small data. Cambridge, United Kingdom: Cambridge University Press. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications, 1st Edition, 2022
<b>Reference Books</b>	1. SQL for Data Scientists: A Beginner's Guide for Building Datasets for Analysis Renee M. P. Teate 2. SQL for Data Science: Data cleaning, wrangling and analytics with relational databases, Antonio Badia 3. Guy Harrison, Next Generation Database: NoSQL & big data, Apress
<b>Website and e-Learning Source</b>	<a href="https://www.geeksforgeeks.org/introduction-to-nosql/">https://www.geeksforgeeks.org/introduction-to-nosql/</a>

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	2	2	3	3
CO2	2	3	2	2	3	3
CO3	2	3	2	2	3	3
CO4	3	3	2	2	3	3
CO5	3	3	2	2	3	3
<b>Weightage of course contributed to each PSO</b>	<b>12</b>	<b>15</b>	<b>10</b>	<b>10</b>	<b>15</b>	<b>15</b>

<b>Title of the Course</b>		<b>Machine Learning – Lab</b>					
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	II				
<b>Instructional Hours per week</b>	<b>Lecture</b>	<b>Tutorial</b>		<b>Lab Practice</b>		<b>Total</b>	
				4		4	
<b>Pre-requisite</b>		Basic Programming Skill and Data Knowledge					
<b>Objectives of the Course</b>		To preprocess the data and build ML models using appropriate techniques and evaluate the model					
<b>Learning Outcome</b>		<p>Upon completion of the course, the student will be able to</p> <p><b>CO1:</b> Apply pandas, NumPy and Matplotlib to read in , process and visualise data, implement linear classification algorithms</p> <p><b>CO2:</b> Compare classifiers with linear and non-linear decision boundaries, select relevant features for the model construction</p> <p><b>CO3:</b> Apply data compression and best practices for model evaluation and hyper parameter tuning</p> <p><b>CO4:</b> Select appropriate algorithms and ensemble</p> <p><b>CO5:</b> Apply clustering algorithms on unlabelled data, construct a web application embedding a ML model</p>					
<b>Course Outline</b>		<b>UNIT-I :</b>					
		<ol style="list-style-type: none"> <li>1. Programs using NumPy and pandas</li> <li>2. Visualising using graphs</li> <li>3. Perceptron learning algorithm</li> <li>4. Adaline</li> </ol>					
		<b>UNIT-II :</b>					
		<ol style="list-style-type: none"> <li>5. Training a perceptron</li> <li>6. Modeling class probabilities via logistic regression</li> <li>7. Maximum margin classification with support vector machines(SVM)</li> <li>8. Solving nonlinear problems using a kernel SVM</li> <li>9. Decision tree</li> </ol>					
		<b>UNIT-III :</b>					
		<ol style="list-style-type: none"> <li>10. Unsupervised dimensionality reduction via principal component analysis</li> <li>11. Supervised data compression via linear discriminant analysis</li> <li>12. Using k-fold cross-validation to assess model performance</li> <li>13. Debugging algorithms with learning and validation curves</li> <li>14. Fine-tuning ML models via grid search</li> <li>15. Implementing different performance evaluation metrics</li> </ol>					
		<b>UNIT-IV :</b>					
		<ol style="list-style-type: none"> <li>16. Ensemble Learning</li> <li>17. Ordinary least squares linear regression model</li> <li>18. Evaluating the performance of linear regression models</li> <li>19. Regularised methods for regression</li> <li>20. Nonlinear relationships using random forests</li> </ol>					

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	<b>UNIT-V:</b> 21. Grouping objects by similarity using k-means 22. Organising clusters as a hierarchical tree 23. Locating regions of high density via DBSCAN 24. Embedding a ML model into a Web Application
Extended Professional Component	1. Mini project applying ML concepts in existing / real time data 2. Comparing the performance of different ML algorithms on a given dataset
Skills acquired from this course	Preprocessing, ML steps, Prediction and Performance evaluation , Embedding ML model into a web application
<b>Recommended Text</b>	1. Corey Wade et al, Vahid Mirjalili, The Python Workshop, 2nd Edition, packs publishing, 2022 2. Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, 3rd Edition, packt publishing, 2019
<b>Reference Books</b>	1. Andreas C. Mueller, Sarah Guido. Introduction to Machine Learning with Python. O’Reilly Media, Inc., 2016. 2. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, <a href="http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&amp;tid=12012">http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&amp;tid=12012</a> , 2010 3. Wes McKinney. Python for Data Analysis. O’Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, second edition, 2018
<b>Website and e-Learning Source</b>	1. <a href="https://machinelearningmastery.com/machine-learning-in-python-step-by-step/">https://machinelearningmastery.com/machine-learning-in-python-step-by-step/</a> 2. <a href="https://www.tutorialspoint.com/machine_learning_with_python/index.htm">https://www.tutorialspoint.com/machine_learning_with_python/index.htm</a> 3. <a href="https://pythonprogramming.net/machine-learning-tutorial-python-introduction/">https://pythonprogramming.net/machine-learning-tutorial-python-introduction/</a>

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	3	3	3
CO2	3	3	2	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	3	2	3	2
CO5	3	3	2	3	3	2
<b>Weightage of course contributed to each PSO</b>	<b>15</b>	<b>13</b>	<b>12</b>	<b>14</b>	<b>13</b>	<b>11</b>

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<b>Title of the Course</b>		<b>BIG DATA ANALYTICS LAB</b>				
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	3	<b>Course Code</b>
		<b>Semester</b>	II			
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		-	-		4	4
<b>Pre-requisite</b>		Basic understanding of programming and logical thinking				
<b>Objectives of the Course</b>		To introduce the concepts of big data analytics and developing a real time applications				
<b>Learning Outcome</b>		<p>Students will be able to</p> <p><b>CO 1:</b> Configure Hadoop and perform File Management</p> <p><b>CO 2:</b> Apply Map Reduce program to real time issues.</p> <p><b>CO 3:</b> Critically analyze huge data set using Hadoop distributed file systems and MapReduce</p> <p><b>CO 4:</b> Experimenting different data processing tools like Pig, Hive.</p> <p><b>CO 5:</b> Develop real time big data analytics applications</p>				
<b>Course Outline</b>		<p><b>UNIT-I :</b></p> <ol style="list-style-type: none"> <li>1. Install Apache Hadoop</li> <li>2. Perform setting up and Installing Hadoop in its three operating modes: <ul style="list-style-type: none"> <li>• Standalone</li> <li>• Pseudo Distributed</li> <li>• Fully Distributed</li> </ul> </li> <li>3. To use Web Based Tools to Manage Hadoop Set-up</li> <li>4. Implement the following file management tasks in Hadoop: <ul style="list-style-type: none"> <li>Adding files and directories</li> <li>Retrieving files &amp; Deleting Files</li> </ul> </li> </ol>				
		<p><b>UNIT-II :</b></p> <ol style="list-style-type: none"> <li>4. Develop a MapReduce program to calculate the frequency of a given word in a given file.</li> <li>5. Develop a MapReduce program to find the maximum temperature in each year.</li> <li>6. Develop a MapReduce program to find the grades of student's.</li> <li>7. Develop a MapReduce program to implement Matrix Multiplication.</li> <li>8. Develop a MapReduce to find the maximum electrical consumption in each year given electrical consumption for each month in each year.</li> </ol>				

	<p><b>UNIT-III :</b></p> <p>9. Develop a MapReduce to analyze weather data set and print whether the day is shiny or cool day. (National Climatic Data Centre (NCDC) Data set)</p> <p>10. Develop a MapReduce program to find the number of products sold in each country by considering sales data containing fields like Transaction _Date Product Price Payment_Type Name City\State Country Account_Created Last_Login Latitude Login</p> <p>11. Data sets from different sources as Input</p> <p>12. Develop a MapReduce program to find the tags associated with each movie by analyzing movie lens data. (<a href="https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset">https://www.kaggle.com/datasets/grouplens/movielens-20m-dataset</a>)</p> <p>12. Sorting the data using MapReduce</p> <p>13. Count the number of missing and invalid values through joining two large given datasets.</p>
	<p><b>UNIT-IV :</b></p> <p>14. Install and Run Pig then write Pig Latin scripts to sort, group, join, project and filter the data.</p> <p>15. Install and Run Hive then use Hive to Create, alter and drop databases, tables, views, functions and Indexes.</p> <p>16. Develop a program to calculate the maximum recorded temperature by year wise for the weather dataset in Pig Latin</p> <p>17. Develop a program to calculate the maximum recorded temperature by year wise for the weather dataset in Pig Latin</p> <p>18. Write queries to sort and aggregate the data in a table using HiveQL</p> <p>19. Develop a MapReduce to find the maximum electrical consumption in each year given electrical consumption for each month in each year.</p> <p>20. Write a program to implement combining and partitioning in hadoop to implement a custom partitioner and Combiner</p>
	<p><b>UNIT-V:</b></p> <p>21. Analyze the sentiment for product reviews, this work proposes a MapReduce technique provided by Apache Hadoop</p> <p>22. Trend Analysis based on Access Pattern over Web Logs using Hadoop.</p> <p>23. Implementation of decision tree algorithms using MapReduce.</p> <p>24. Implementation of K-means Clustering using MapReduce.</p> <p>25. Generation of Frequent Itemset using MapReduce.</p>
<p>Extended Professional Component</p>	<p>Mini Project – Application development (is a part of internal component only, Not to be included in the External Examination question paper)</p>
<p>Skills acquired from this course</p>	<p>Developing application using big data analytic techniques</p>
<p><b>Recommended Text</b></p>	<p>1. Big Data and Analytics, Seema Acharya, Subhashini Chellappan, First Edition, 2015, Wiley. 2. Tom White, Hadoop: The Definitive Guide, O’Reilly Media Inc., 2015.</p>

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<b>Reference Books</b>	<p>1. Lublinsky, Boris, Kevin T. Smith, and Alexey Yakubovich. Professional hadoop solutions. John Wiley &amp; Sons, 2013.</p> <p>2. Big Data Analytics, RadhaShankarmani, M Vijayalakshmi, Second Edition, 2017, Wiley</p> <p>3. Hadoop Essentials: A Quantitative Approach, Henry H. Liu, First Edition, 2012, PerfMath Publishers</p>
<b>Website and e-Learning Source</b>	<p><a href="https://www.ibm.com/analytics/big-data-analytics">https://www.ibm.com/analytics/big-data-analytics</a></p> <p><a href="https://www.simplilearn.com/what-is-big-data-analytics-article">https://www.simplilearn.com/what-is-big-data-analytics-article</a></p> <p><a href="https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-big-data-analytics">https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-big-data-analytics</a></p>

**Course Learning Outcome (for Mapping with POs and PSOs)**

	<b>PSOs</b>						
	<b>1</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>CO1</b>	3	3	3	3	2	1	1
<b>CO2</b>	3	3	3	3	2	1	1
<b>CO3</b>	3	3	3	3	2	1	1
<b>CO4</b>	3	3	3	3	2	1	1
<b>CO5</b>	3	3	3	3	2	1	1
<b>Weightage of course contributed to each PO/PSO</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>10</b>	<b>5</b>	<b>5</b>

<b>Title of the Course</b>		<b>SOCIAL NETWORK ANALYSIS</b>					
<b>Category</b>	<b>Skill</b>	<b>Year</b>	I	<b>Credits</b>	2	<b>Course Code</b>	
		<b>Semester</b>	II				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>	
		4			--	4	
<b>Pre-requisite</b>		Basic understanding of social networks					
<b>Objectives of the Course</b>		To introduce the concepts and fundamentals of social network components and analysis					
<b>Course Outline</b>		<b>UNIT-I: INTRODUCTION TO SEMANTIC WEB AND SOCIAL NETWORKS</b>					
		<p>Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis- Brief history of Social network analysis</p> <p><b>Book 1- Chapter 1,2,3 Book 2: Chapter 1</b></p>					
		<b>UNIT-II: MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION</b>					
		<p>Knowledge Representation on the semantic web- Ontology and their role in the Semantic Web - Ontology languages for the Semantic Web- Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations</p> <p><b>Book 1: Chapter 4,5,6</b></p>					



	<p><b>UNIT-III: DATA COLLECTION</b></p> <p>Boundary specification – Data collection process- Information bias and issue of reliability – Archival data – Understanding SNA data – Managing SNA data</p> <p><b>Book2 : Chapter 2</b></p> <hr/> <p><b>UNIT-IV : METHODS IN SOCIAL NETWORK ANALYSIS</b></p> <p>Descriptive methods – Graph – Density- Centrality – cliques – MDS- structural equivalence – Two mode networks – Inferential methods – QAP- ERGM</p> <p><b>Book 2- Chapter 3, 4</b></p> <hr/> <p><b>UNIT-V: CASE STUDIES</b></p> <p>Case studies – Evaluation of web-based social network extraction – semantic – based social network analysis in the sciences – emergent semantics</p> <p><b>Book 1: Chapter 7,8,9</b></p>
<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>Case study on recent developments and presentation</p>
<p>Skills acquired from this course</p>	<p>Apply social network in real time applications</p>
<p><b>Recommended Text</b></p>	<p>1. Peter Mika, “Social Networks and the Semantic Web”, Springer 2007.</p> <p>2. Yang, Song, Franziska B. Keller, and Lu Zheng. Social network analysis: Methods and examples. Sage Publications, 2016.</p>

<b>Reference Books</b>	<p>1. Guandong Xu ,Yanchun Zhang and Lin Li, —Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.</p> <p>2. Dion Goh and Schubert Foo, —Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.</p>
<b>Website and e-Learning Source</b>	<p><a href="https://bookdown.org/chen/snaEd/ch4.html">https://bookdown.org/chen/snaEd/ch4.html</a></p> <p><a href="https://www.sciencedirect.com/topics/social-sciences/social-network-analysis">https://www.sciencedirect.com/topics/social-sciences/social-network-analysis</a></p> <p><a href="https://www.publichealth.columbia.edu/research/population-health-methods/social-network-analysis">https://www.publichealth.columbia.edu/research/population-health-methods/social-network-analysis</a></p> <p><a href="https://www.ibm.com/docs/en/spss-modeler/18.0.0?topic=analysis-about-social-network">https://www.ibm.com/docs/en/spss-modeler/18.0.0?topic=analysis-about-social-network</a></p>

**Course Learning Outcome (for Mapping with POs and PSOs)**

Students will be able to

<b>CO's</b>	<b>Course Outcomes</b>
<b>CLO1</b>	Understand the fundamentals of social web and elements of social network analysis.
<b>CLO2</b>	Apply and visualize the knowledge representation in social network.
<b>CLO3</b>	Analyse the various methods in social network analysis.
<b>CLO4</b>	Evaluate the tools and methods for analysing the social network data.
<b>CLO5</b>	Investigate the recent potential applications and development of social network with real time case studies.

<b>CO/PSO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	<b>PSO6</b>
<b>CLO1</b>	3	3	3	2	1	1
<b>CLO2</b>	3	3	3	2	1	1
<b>CLO3</b>	3	3	3	2	1	1
<b>CLO4</b>	3	3	3	2	1	1
<b>CLO5</b>	3	3	3	2	1	1
<b>Weightage of course contribute to each PSO</b>						