



Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Information Technology

Choice Based Credit System (CBCS) in the light of NEP-2020

M.Tech (CSE)

SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS201 N	DCC	Advance Computer Architecture & Organization	Max	60	20	20	0	0	3	0	0	3
			Min	24	16		0	0				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Describe current and emerging trends in computer architectures, focusing on performance and the hardware/software interface.
2. Analyzing fundamental issues in architecture design and their impact on application performance.
3. Identify the performance and efficiency in advanced multiple-issue processors
4. Identify and Analyzing various memory models.
5. Describe various techniques to enhance a processors ability.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)** and **SDG 9 (Industry, Innovation and Infrastructure)**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

- CO1** Know the classes of computers, and new trends and developments in computer architecture.
- CO2** Understand pipelining, instruction set architectures, memory addressing.
- CO3** Understand symmetric shared-memory architectures and their performance.
- CO4** Understand multiprocessor cache coherence using the directory based and snooping class of protocols.
- CO5** Understand the various models to achieve memory consistency.

TEACHING PEDAGOGY:

- T1** Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching

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MTCS201 N	DCC	Advance Computer Architecture & Organization	Max	60	20	20	0	0	3	0	0	3
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T2 ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

- ATL1 Quiz
- ATL2 Activity Based Learning
- ATL3 Midterm Exams
- ATL4 Flip Class
- ATL5 Seminar Presentation
- ATL6 Assignments
- ATL7 Poster
- ATL8 Oral Viva-voce examination
- ATL9 Industrial Visit Report

PREREQUISITES:

Basic Computer Knowledge

SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment Tools
I	Overview of Parallel Processing and Pipelining Processing, study and comparison of uni-processors and parallel processors, Evolution of parallel processors, Necessity of high performance, Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism.	10	ATL1 ATL4 ATL6
II	Principles and implementation of Pipelining, Pipeline Architecture, Study and comparison of processors with and without pipelining, Linear pipeline processor, Nonlinear pipeline processor Instruction pipeline design, Mechanisms for instruction pipelining, pipeline hazards, Dynamic instruction scheduling -score boarding and	9	ATL2 ATL3 ATL8

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MTCS201 N	DCC	Advance Computer Architecture & Organization	Max	60	20	20	0	0	3	0	0	3
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	Tomosulo's algorithm, Branch handling techniques, Arithmetic Pipeline Design, Static arithmetic pipeline, Multifunctional arithmetic pipelines. Superscaler pipeline design, Super pipeline processor design.		
III	Study and comparison of Vector and array processors, Vector Processing Principles, Vector instruction types, Vector-access memory schemes. Vector supercomputer architecture, SIMD Computer Organization Masking and Data network mechanism, distributed memory model and shared memory model, Parallel Algorithms For Array Processors: Matrix Multiplication. Sorting, SIMD computer organization, Implementation issues of Matrix multiplication and sorting on array processor and their analysis.	8	ATL2 ATL3 ATL5
IV	Microprocessor Architectures, study and comparison of Loosely and Tightly coupled multiprocessors. Loosely and Tightly coupled multiprocessors, Processor characteristics of multiprocessors, Inter Processor communication network, Time shared bus, Crossbar switch, Multiport Memory Model, Memory contention and arbitration techniques, Cache coherence, Snoopy protocols, Directory based protocols. Message routing schemes in multicomputer network, deadlock and virtual channel.	7	ATL2 ATL5 ATL8
V	Study of Architecture of Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions, Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Message passing parallel programming, Shared Memory Programming, Data Parallel Programming. Implementation issues of a multithreaded program.	8	ATL5 ATL7 ATL9
Total Hours		30	

ADDITIONAL RESOURCES

A. Value addition to course content/ Skill enhancement content:

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			Marks	THEORY			PRACTICAL					
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MTCS201 N	DCC	Advance Computer Architecture & Organization	Max	60	20	20	0	0	3	0	0	3
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Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

<https://nptel.ac.in/courses/106106166>

B. Remedial classes for slow learners:

As per the SVVV SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

1. K. Hwang and F. A. Briggs, *Computer Architecture and Parallel Processing*. New York, NY, USA: McGraw-Hill International Editions, 1984.
2. J. P. Hayes, *Computer Architecture and Organization*, 3rd ed. New York, NY, USA: McGraw-Hill, 1998.

Reference Books

1. V. Rajaraman and C. S. R. Murthy, *Parallel Computers: Architecture and Programming*. New Delhi, India: PHI Learning, 2000.
2. R. Kain, *Advanced Computer Architecture: A Systems Design Approach*. New Delhi, India: PHI Learning, 2010.
3. M. J. Flynn, *Computer Architecture: Pipelined and Parallel Processor Design*. New Delhi, India: Narosa Publishing House, 1995.
4. K. Hwang and F. A. Briggs, *Computer Architecture and Parallel Processing*. New York, NY, USA: McGraw-Hill, 1984.
5. D. E. Culler and J. P. Singh, *Parallel Computer Architecture: A Hardware/Software Approach*. San Francisco, CA, USA: Morgan Kaufmann Publishers, 1999.

Suggested resources (Websites/e-books)

1. S. G. Shiva, *Advanced Computer Architecture*. Boca Raton, FL, USA: CRC Press (Taylor & Francis Group), 2000.

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS201 N	DCC	Advance Computer Architecture & Organization	Max	60	20	20	0	0	3	0	0	3
			Min	24	16		0	0				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Outcome s	Correlation with POs												Correlation with PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	-	-	-	1	1	-	3	2	1	1
CO2	3	3	2	2	3	2	-	3	2	2	1	3	3	1	3
CO3	3	3	3	3	3	2	1	2	3	2	2	3	3	2	3
CO4	1	2	3	2	2	3	3	2	3	3	2	1	2	3	1
CO5	3	2	1	2	3	1	2	3	2	2	3	3	2	3	1

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			Ma rks	THEORY			PRACTICAL					
				END SEM Unive rsity Exam	Tw o Te rm Ex am	Te ac he rs As ses sm ent *	END SEM Unive rsity Exam	Te ac he rs As ses sm ent *				
MTCS202 N	DCC	Advance Database Management System	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Describe database management system internals. Understand and describe internal algorithms in detail. Decide on optimization issues given a known database workload, by manipulating indexes, choosing more adequate data types, and modifying queries.
2. Identify opportunities for the use of the object model, and design and code client code to manipulate an object database.
3. Analyze and optimize transactional code, identifying causes of possible anomalies and correct them.
4. Identify and be able to use recent and advanced database techniques (e.g. in concurrency control, buffer management, and recovery).
5. Analyze, describe and use other models than the Relational. Analyze, compare and evaluate alternative database architectures and models in different application contexts. Identify limitations of the standard Relational databases in certain application domains, e.g. for multidimensional data, or unstructured data.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)** and **SDG 9 (Industry, Innovation and Infrastructure)**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

- CO1** Be familiar with a commercial relational database system (Oracle) by writing SQL using the system.
- CO2** Be familiar with the relational database theory, and be able to write relational algebra expressions for queries.
- CO3** Be familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B-tree, and hashing.
- CO4** Master the basics of query evaluation techniques and query optimization.
- CO5** Be familiar with the basic issues of transaction processing and concurrency control.

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			Ma rks	THEORY			PRACTICAL					
				END SEM Unive rsity Exam	Tw o Te rm Ex am	Te ac he rs As ses sm ent *	END SEM Unive rsity Exam	Te ac he rs As ses sm ent *				
MTCS202 N	DCC	Advance Database Management System	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

TEACHING PEDAGOGY:

- T1** Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2 ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

- ATL1** Quiz
ATL2 Activity Based Learning
ATL3 Midterm Exams
ATL4 Flip Class
ATL5 Seminar Presentation
ATL6 Assignments
ATL7 Poster
ATL8 Oral Viva-voce examination
ATL9 Industrial Visit Report

PREREQUISITES:

Basic Computer Knowledge

SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment Tools
I	Introduction to Database Systems: Database System Concepts and Architecture, Data Models, Data Independence, SQL: DDL, DML, DCL, Normalization: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF. Query Processing and Optimization: Query Processing, Syntax Analyzer, Query Decomposition, Query Optimization, Heuristic Query Optimization, Cost Estimation, Cost Functions for Select, Join, Query	10	ATL1 ATL2 ATL6

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	Evaluation Plans.		
II	Object Oriented and Object Relational Databases: Object Oriented Concepts, Object Oriented Data Model, Object Definition Language, Object Query Language, Object Relational Systems, SQL3, ORDBMS Design.	9	ATL4 ATL5 ATL8
III	Transaction Processing and Concurrency Control: Transaction Processing Concepts, Concurrency Control Techniques: Two-phase Locking, Timestamp Ordering, Multiversion, Validation, Multiple Granularity Locking.	8	ATL2 ATL3 ATL8
IV	Backup and Recovery: Types of Database Failures, Types of Database Recovery, Recovery Techniques: Deferred Update, Immediate Update, Shadow Paging, Checkpoints, Buffer Management.	7	ATL2 ATL3 ATL6
V	Introduction to Data Warehousing and Data Mining: Introduction to OLAP, OLTP, Data Warehouse, Data Marts, Data Mining, Data Mining Process. Distributed Databases: Distributed Database Concepts, Advantages and Disadvantages, Types of Distributed Database Systems, Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design, Five Level Schema Architecture, Query Processing, Concurrency Control and Recovery in Distributed Databases. Commercial Databases: Commercial Database Products, Familiarity with IBM DB2 Universal Database, Oracle, Microsoft SQL Server, MySQL, their features.	8	ATL5 ATL7 ATL9
	Total Hours	30	

ADDITIONAL RESOURCES

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A. Value addition to course content/ Skill enhancement content:

<https://education.oracle.com/oracle-database-foundations>

B. Remedial classes for slow learners:

As per the AUMP SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

1. C. J. Date, *An Introduction to Database Systems*, 8th ed. Boston, MA, USA: Addison-Wesley, 2003.
2. A. Silberschatz, H. F. Korth, and S. Sudarshan, *Database System Concepts*, 6th ed. New York, NY, USA: McGraw-Hill Education, 2011.

Reference Books

1. P. O'Neil and E. O'Neil, *Database: Principles, Programming, and Performance*, 2nd ed. San Francisco, CA, USA: Morgan Kaufmann Publishers, 2001.
2. M. L. Gillenson, *Fundamentals of Database Management Systems*. Hoboken, NJ, USA: Wiley India, 2005.
3. S. Ceri and G. Pelagatti, *Distributed Databases: Principles and Systems*. New York, NY, USA: McGraw-Hill, 1984.
4. P. Ponniah, *Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals*, 2nd ed. Hoboken, NJ, USA: Wiley India, 2010.

Suggested resources (Websites/e-books)

- 1 J. Han, M. Kamber, and J. Pei, *Data Mining: Concepts and Techniques*, 3rd ed. Waltham, MA, USA: Elsevier/Morgan Kaufmann, 2011.

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LIST OF PRACTICAL

	Title	CO Mapping
1.	Distributed Database for Bookstore.	CO1
2.	Deadlock Detection Algorithm for distributed database using wait- for graph.	CO1
3.	Object Oriented Database – Extended Entity Relationship (EER).	CO1
4.	Parallel Database – University Counselling for Engineering colleges.	CO2
5.	Parallel Database – Implementation of Parallel Join & Parallel Sort.	CO2
6.	Active Database – Implementation of Triggers & Assertions for Bank Database.	CO3
7.	Deductive Database – Constructing Knowledge Database for Kinship Domain (Family Relations).	CO3
8.	Study and working of WEKA Tool.	CO4
9.	Query Processing – Implementation of an Efficient Query Optimizer.	CO4
10.	Designing XML Schema for Company Database.	CO5

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcomes	Correlation with POs												Correlation with PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	-	-	-	1	1	-	3	2	1	1
CO2	3	3	2	2	3	2	-	3	2	2	1	3	3	1	3
CO3	3	3	3	3	3	2	1	2	3	2	2	3	3	2	3
CO4	2	1	2	1	2	3	2	2	3	3	2	3	1	2	3
CO5	2	1	3	1	2	2	1	2	3	2	2	3	3	2	3

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M.Tech CSE/ CSE(/DS/BDA/AI) / DS / BDA / AI / IS

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRM301	AECC	Research Methodology in Engineering	Max	60	20	20	0	0	3	1	0	4
			Min	24	16		0	45				

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COURSE OBJECTIVES:

The student will have ability to:

1. The ensuing knowledge as property.
2. To plan and design business research using scientific and statistical methods.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)** and **SDG 9 (Industry, Innovation and Infrastructure)**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

- CO1** Demonstrate understanding of research methodology.
- CO2** Apply the statistical concepts in business research.
- CO3** Validate statistical statements relating to business research.

TEACHING PEDAGOGY:

- T1** Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
- T2** ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

- ATL1** Quiz
- ATL2** Activity Based Learning
- ATL3** Midterm Exams
- ATL4** Flip Class
- ATL5** Seminar Presentation
- ATL6** Assignments
- ATL7** Poster
- ATL8** Oral Viva-voce examination
- ATL9** Industrial Visit Report

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Choice Based Credit System (CBCS) in the light of NEP-2020

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SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRM301	AECC	Research Methodology in Engineering	Max	60	20	20	0	0	3	1	0	4
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

PREREQUISITES:

Basic Computer Knowledge

SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment Tools
I	Business Research 1. An overview: Research process 2. Types of Research - Exploratory Research, Descriptive Research, Causal Research, Analytical Research 3. Problem formulation, Management problem v/s. Research problem 4. Approaches to Research 5. Importance of literature review 6. Business Research Design: Steps involved in a research design	10	ATL1 ATL2 ATL6
II	Sampling and Data Collection 1. Sampling and sampling distribution: Meaning, Steps in Sampling process 2. Types of Sampling - Probability and Non probability Sampling Techniques 3. Data collection: Primary and Secondary data – Sources – Advantages/Disadvantages 4. Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	9	ATL2 ATL8
III	Measurement and Scaling Techniques 1. Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement 2. Attitude measurement – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale	8	ATL1 ATL6
IV	Statistical Tools for Data Analysis 1. Measures of central tendency - Mean, Median, Mode ,Quartiles, Deciles and Percentiles	7	ATL5 ATL7

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SEMESTER-II (2026-28)

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			Marks	THEORY			PRACTICAL					
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			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

	2. Measures of Dispersion: Standard Deviation – Variance – Coefficient of Variance, Skewness 3. Correlation - Karl Pearson's coefficient of Correlation, Rank Correlation 4. Regression: Method of Least Squares 5. Formulation of hypothesis 6. Testing of hypothesis 7. Type I and Type II Errors. 8. Parametric tests: Z-Test, t-test, F-test, Analysis of Variance – One-Way and Two-way classification. 9. Non parametric tests - Chi-Square test		
V	Report writing 1.Reporting Research 2.Types of reports 3.Characteristics of a research report	8	ATL4 ATL9
	Total Hours	30	

ADDITIONAL RESOURCES

A. Value addition to course content/ Skill enhancement content:

<https://nptel.ac.in/courses/109105196>

B. Remedial classes for slow learners:

As per the SVVV SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

1. N. K. Malhotra, *Marketing Research: An Applied Orientation*, 6th ed. Noida, India: Pearson Education, 2008.
2. W. G. Zikmund, B. J. Babin, J. C. Carr, and M. Griffin, *Business Research Methods*, 7th ed. New Delhi, India: Cengage Learning, 2003

Reference Books

1. D. R. Cooper and P. S. Schindler, *Business Research Methods*, 9th ed. New York, NY, USA: McGraw-

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTRM301	AECC	Research Methodology in Engineering	Max	60	20	20	0	0	3	1	0	4
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Hill Education, 2006.

2. D. R. Anderson, D. J. Sweeney, T. A. Williams, and J. D. Camm, *Statistics for Business and Economics*, 12th ed. Boston, MA, USA: Cengage Learning, 2014.
3. O. R. Krishnaswami and M. Ranganatham, *Methodology of Research in Social Sciences*. Mumbai, India: Himalaya Publishing House, 2011.
4. R. I. Levin and D. S. Rubin, *Statistics for Management*, 7th ed. New Delhi, India: Dorling Kindersley (India) Pvt. Ltd., 2008.
5. U. Sekaran and R. Bougie, *Research Methods for Business: A Skill Building Approach*, 4th ed. New Delhi, India: Wiley India, 2003.

Suggested resources (Websites/e-books)

- 1 S. P. Gupta, *Statistical Methods*, 43rd ed. New Delhi, India: Sultan Chand & Sons, 2014.
- 2 A. D. Aczel and J. Sounderpandian, *Complete Business Statistics*, 7th ed. New Delhi, India: Tata McGraw-Hill, 2008.

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcome s	Correlation with POs												Correlation with PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	-	-	-	1	1	-	3	2	1	1
CO2	3	3	2	2	3	2	-	3	2	2	1	3	3	1	3
CO3	3	3	3	3	3	2	1	2	3	2	2	3	3	2	3

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2051	DSE	Reinforcement Learning	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Develop a Comprehensive Understanding.
2. Master Data Preparation and Modeling.
3. Apply Advanced Analytics Techniques.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

- CO1** Understand the core principles of reinforcement learning.
- CO2** Understand the model decision-making process using Markov Decision making processes.
- CO3** Understand and apply exploration and exploitation strategies in reinforcement learning.
- CO4** Acquire Skills in Monte Carlo methods for practical policy evaluation and control.
- CO5** Understand function approximation in the context of Reinforcement Learning.

TEACHING PEDAGOGY:

- T1** Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
- T2** ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

- ATL1** Quiz
- ATL2** Activity Based Learning
- ATL3** Midterm Exams
- ATL4** Flip Class
- ATL5** Seminar Presentation
- ATL6** Assignments
- ATL7** Poster
- ATL8** Oral Viva-voce examination

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2051	DSE	Reinforcement Learning	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

ATL9 Industrial Visit Report

PREREQUISITES:

Basic Computer Knowledge

SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment Tools
I	Overview of reinforcement learning, Difference between supervised, unsupervised, and reinforcement learning, Components of reinforcement learning (agent, environment, state, action, reward, transaction function, Discount, episode), Bandit problem.	8	ATL1 ATL3
II	Understanding Markov Decision Processes (MDPs), Policy, State value function, Action value function, Bellman equation, Dynamic Programming—Policy iteration, Policy Improvement, Value iteration, and Limitations of dynamic programming.	8	ATL6 ATL8
III	Exploration and exploitation strategies- Random, Greedy, Epsilon-Greedy, Softmax, UCB. Monte Carlo Methods: First-Visit Monte Carlo, Every-Visit Monte Carlo, Monte Carlo simulation for policy evaluation.	10	ATL4 ATL7
IV	Temporal Difference Learning (TD), n-step TD, Q-learning, SARSA, bootstrapping.	10	ATL5 ATL8
V	Function Approximation, linear function approximation, Deep Q-networks (DQN), Double Deep Q-networks (DDQN), Dueling Q-networks (Dueling DQN), Policy gradient methods, and Actor Critic methods.	8	ATL4 ATL9
Total Hours		30	

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2051	DSE	Reinforcement Learning	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

ADDITIONAL RESOURCES

A. Value addition to course content/ Skill enhancement content:

<https://www.deeplearning.ai/courses/unsupervised-learning-recommenders-reinforcement-learning>

B. Remedial classes for slow learners:

As per the SVVV SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

1. R. S. Sutton and A. G. Barto, *Reinforcement Learning: An Introduction*, 2nd ed. Cambridge, MA, USA: MIT Press, 2018.
2. M. Morales, *Grokking Deep Reinforcement Learning*. Shelter Island, NY, USA: Manning Publications, 2020.

Reference Books

1. A. Zai and B. Brown, *Deep Reinforcement Learning in Action*, 1st ed. Shelter Island, NY, USA: Manning Publications, 2020.
2. M. Sewak, *Deep Reinforcement Learning: Frontiers of Artificial Intelligence*. Singapore: Springer, 2019.

Suggested resources (Websites/e-books)

1. M. Sugiyama, *Statistical Reinforcement Learning: Modern Machine Learning Approaches*. Boca Raton, FL, USA: Chapman and Hall/CRC, 2015.

LIST OF PRACTICAL

	Title	CO Mapping
1.	Understand agent–environment interaction and the RL loop through a simple simulation.	CO1
2.	Differentiate learning paradigms using small examples.	CO1
3.	Implement and analyze the k-armed bandit problem.	CO1,03
4.	Represent and visualize an MDP for a small environment (e.g., Grid World).	CO2

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2051	DSE	Reinforcement Learning	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

5.	Implement iterative policy evaluation for a known policy.	CO2
6.	Implement Monte Carlo methods for value estimation.	CO2,04
7.	Implement one-step TD learning for state-value prediction.	CO2,04
8.	Implement and train a DQN agent.	CO2,03,08

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcome s	Correlation with POs												Correlation with PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	-	-	-	1	1	-	3	2	1	1
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CO3	3	3	3	3	3	2	1	2	3	2	2	3	3	2	3
CO4	3	2	2	1	3	3	1	3	-	1	1	-	3	2	1
CO5	3	3	3	3	3	2	1	2	3	2	2	3	3	2	3

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SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2052	DSE	Natural Language Processing	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Identify deals with processing text data using probabilistic model with n-grams and pre processing techniques.
2. Concepts of text classification, text summarization, semantic analysis drives the subject to machine translation.
3. Student knowledge to a level that can help to develop NLP applications like surveys, chatbots QA system etc..

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)** and **SDG 9 (Industry, Innovation and Infrastructure)**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

- CO1** Understand the basic concepts and requirements of NLP.
- CO2** Understand and apply various NLP Models and Algorithms.
- CO3** Design and develop basic applications for text or information extraction.
- CO4** Apply Machine translation techniques for language translation.

TEACHING PEDAGOGY:

- T1** Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
- T2** ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

- ATL1** Quiz
- ATL2** Activity Based Learning
- ATL3** Midterm Exams
- ATL4** Flip Class
- ATL5** Seminar Presentation
- ATL6** Assignments
- ATL7** Poster

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			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

ATL8 Oral Viva-voce examination

ATL9 Industrial Visit Report

PREREQUISITES:

Basic Computer Knowledge

SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment Tools
I	Introduction to NLP: What is NLP? Challenges of NLP, History of NLP, Advantages of NLP, Disadvantages of NLP, Components of NLP, Applications of NLP, how to build an NLP pipeline? Phases of NLP, NLP APIs, NLP Libraries.	8	ATL1 ATL4 ATL6
II	Natural Language Processing Models and Algorithm: Unigram Language Model, Bigram, Trigram, N-gram, Advanced smoothing for language modelling, Applications of Language Modelling, Natural Language Generation, Parts of Speech Tagging, Morphology, Named Entity Recognition.	9	ATL2 ATL5 ATL8
III	Text Processing: Continuous Bag-Of-Words, embedding representations for words Lexical Semantics, Word Sense Disambiguation, Knowledge-Based and Supervised Word Sense Disambiguation, Tokenization, Cleaning, Tokenizing, Removing Special Characters, Expanding Contractions, Removing Stop words, Correcting Words, Stemming, Lemmatization, Understanding Text structure.	8	ATL5 ATL8
IV	Text Analysis, Summarization and Extraction: Text Classification, Text Summarization, Information Extraction, Named Entity Recognition, Question Answering in Multilingual Setting; NLP in Information Retrieval, Cross-Lingual IR.	7	ATL7 ATL9

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			Marks	THEORY			PRACTICAL					
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MTCS2052	DSE	Natural Language Processing	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

V	Applications of NLP: Unsupervised Learning on Text Clustering by Document Similarity – Distance Metrics, Partitive Clustering, Hierarchical Clustering: Analyzing Document Similarity, Document Clustering, Speech recognition.	8	ATL7
Total Hours		30	

ADDITIONAL RESOURCES

A. Value addition to course content/ Skill enhancement content:

<https://www.deeplearning.ai/courses/natural-language-processing-specialization>

B. Remedial classes for slow learners:

As per the SVVV SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

- C. D. Manning and H. Schütze, *Foundations of Statistical Natural Language Processing*. Cambridge, MA, USA: MIT Press, 1999.
- J. Allen, *Natural Language Understanding*, 2nd ed. Redwood City, CA, USA: Benjamin/Cummings Publishing Company, 1995.

Reference Books

- G. A. Kiraz, *Computational Nonlinear Morphology: With Emphasis on Semitic Languages*. Cambridge, U.K.: Cambridge University Press, 2001.
- S. Bird, E. Klein, and E. Loper, *Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit*. Sebastopol, CA, USA: O'Reilly Media, 2009.
- D. Jurafsky and J. H. Martin, *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*, 2nd ed. New Delhi, India: Pearson Education, 2009.

Suggested resources (Websites/e-books)

- H. Lane, C. Howard, and H. Hapke, *Natural Language Processing in Action*. Shelter Island, NY, USA: Manning Publications, 2019.

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2052	DSE	Natural Language Processing	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

LIST OF PRACTICAL

	Title	CO Mapping
1.	Introduction to python libraries for feature extraction and NLP.	CO1
2.	Apply pre processing steps on the selected Dataset. Support link for data set: https://www.kaggle.com/learn/natural-language-processing .	CO1
3.	Tokenization: Split the text sentence/paragraph/Data set and generate Tokens.	CO1
4.	Implement a suitable stemming algorithm based on the chosen data set.	CO2
5.	POS tagging part 1: Perform POS tagging annotation on input text.	CO2
6.	POS tagging part 2: Analyze the result of POS Tagging.	CO3
7.	Generate N-grams of the text.	CO3
8.	Convert text into TF IDF vectors.	CO3
9.	Case Study – Study and prepare a report of Machine translation of Google.	CO4
10.	Case Study - Identify the sentiment of tweets.	CO4

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcome s	Correlation with POs												Correlation with PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	-	-	-	1	1	-	3	2	1	1
CO2	3	3	2	2	3	2	-	3	2	2	1	3	3	1	3
CO3	3	3	3	3	3	2	1	2	3	2	2	3	3	2	3
CO4	1	3	-	-	-	1	1	-	3	2	1	1	2	3	3

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Choice Based Credit System (CBCS) in the light of NEP-2020

M.Tech CSE (ARTIFICIAL INTELLIGENCE)/AI/ CSE (DS/BDA)/ DS / BDA

SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2041	DSE	Introduction to Statistical Methods	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Understanding Probability and Distributions.
2. Mastering Descriptive Statistics and Estimation Techniques.
3. Applying Regression and Correlation Analysis.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)** and **SDG 9 (Industry, Innovation and Infrastructure)**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

- CO1** Proficiency in Probability Concepts and Distributions.
CO2 Competency in Descriptive Statistics and Estimation.
CO3 Expertise in Regression and Correlation Analysis.

TEACHING PEDAGOGY:

- T1** Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2 ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

- ATL1** Quiz
ATL2 Activity Based Learning
ATL3 Midterm Exams
ATL4 Flip Class
ATL5 Seminar Presentation
ATL6 Assignments
ATL7 Poster
ATL8 Oral Viva-voce examination
ATL9 Industrial Visit Report

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Choice Based Credit System (CBCS) in the light of NEP-2020

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SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2041	DSE	Introduction to Statistical Methods	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

PREREQUISITES:

Basic Computer Knowledge

SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment Tools
I	Introduction to probability: Probability, conditional probability, independence, Bayes' theorem. Random variables: discrete and continuous, distribution functions and their properties, probability mass and density functions, expectation & moments, moment generating function & its properties. Multiple random variables: joint distributions, marginal and conditional distributions. Discrete probability distributions: Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric and Poisson distribution. Continuous probability distributions: Uniform, Exponential, Gamma, Normal & Log-normal distribution.	10	ATL1 ATL3 ATL8
II	Descriptive Statistics: Inferential statistics, population, sample, parameter, statistic, random sample, sampling techniques. Summarizing and Exploring Data: Concept of frequency distribution, measures of central tendency, moments, measures of dispersion/variability, measures of skewness and kurtosis.	9	ATL1 ATL2
III	Estimation: Sampling distributions, basic concepts of inference (estimation & hypothesis testing), point estimation & interval estimation	8	ATL3 ATL6 ATL8
IV	Testing of Hypothesis: Null and alternate hypothesis, simple & composite hypotheses, critical region, N-P lemma, tests for mean, variance and proportion in one and two sample problems. Chi-square goodness of fit test. Introduction to nonparametric test, Contingency table, test of independence.	10	ATL2 ATL5

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2041	DSE	Introduction to Statistical Methods	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

V	Regression and Correlation: Simple linear regression, least squares fit and correlation analysis. Tests for slope & correlation, prediction problem, residual plots. Multiple linear regression, Analysis of Variance.	8	ATL2 ATL3 ATL6
Total Hours		30	

ADDITIONAL RESOURCES

A. Value addition to course content/ Skill enhancement content:

<https://www.coursera.org/specializations/statistics-with-python>

B. Remedial classes for slow learners:

As per the SVVV SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

- W. W. Hines, D. C. Montgomery, D. M. Goldsman, and C. M. Borror, *Probability and Statistics in Engineering*, 4th ed. Hoboken, NJ, USA: Wiley, 2003.
- V. K. Rohatgi and A. K. M. E. Saleh, *An Introduction to Probability and Statistics*, 2nd ed. Hoboken, NJ, USA: Wiley, 2001.

Reference Books

- S. M. Ross, *Introduction to Probability Models*, 11th ed. Amsterdam, Netherlands: Academic Press, 2014.
- M. R. Spiegel, J. Schiller, and R. A. Srinivasan, *Probability and Statistics*, 4th ed. New Delhi, India: Tata McGraw-Hill Education, 2013.
- R. A. Johnson, *Miller and Freund's Probability and Statistics for Engineers*, 9th ed. Noida, India: Pearson Education, 2011.

Suggested resources (Websites/e-books)

- J. S. Milton and J. C. Arnold, *Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences*, 4th ed. New York, NY, USA: McGraw-Hill, 2003.

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2041	DSE	Introduction to Statistical Methods	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

LIST OF PRACTICAL

	Title	CO Mapping
1.	Conduct experiments to calculate probabilities using classical, frequency, and axiomatic approaches. Apply Bayes' theorem to real-world scenarios.	CO1
2.	Implement and analyze the Bernoulli, Binomial, Geometric, Negative Binomial, Hypergeometric, and Poisson distributions using sample data.	CO1
3.	Develop and interpret continuous probability distributions.	CO1
4.	Write Python scripts to perform descriptive statistical analysis and visualize various probability distributions.	CO2
5.	Calculate point estimates and construct confidence intervals for different parameters using sample data. Perform estimation using Python.	CO2
6.	Hypothesis Testing for Means and Variances.	CO2
7.	Chi-Square Goodness of Fit and Independence Tests.	CO2
8.	Simple and Multiple Linear Regression.	CO2
9.	ANOVA and Correlation Analysis.	CO3

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcomes	Correlation with POs												Correlation with PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	-	-	-	1	1	-	3	2	1	1
CO2	3	3	2	2	3	2	-	3	2	2	1	3	3	1	3
CO3	3	3	3	3	3	2	1	2	3	2	2	3	3	2	3

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SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2042	DSE	DATA WAREHOUSING	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Understand the components and architecture of data warehousing and data mining systems.
2. Implement data preprocessing, cleaning, integration, and transformation techniques.
3. Analyze and evaluate clustering methods, classification algorithms, and regression models for data analysis.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)** and **SDG 9 (Industry, Innovation and Infrastructure)**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

- CO1** Describe the architecture and functionalities of data warehousing and data mining systems.
- CO2** Implement data extraction, cleanup, and transformation processes using appropriate tools.
- CO3** Evaluate various clustering, classification, and regression methods, assessing their effectiveness in different scenarios.

TEACHING PEDAGOGY:

- T1** Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
- T2** ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

- ATL1** Quiz
- ATL2** Activity Based Learning
- ATL3** Midterm Exams
- ATL4** Flip Class
- ATL5** Seminar Presentation
- ATL6** Assignments
- ATL7** Poster
- ATL8** Oral Viva-voce examination

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2042	DSE	DATA WAREHOUSING	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

ATL9 Industrial Visit Report

PREREQUISITES:

Basic Computer Knowledge

SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment Tools
I	Data Warehousing and Business Analysis: Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.	10	ATL1 ATL2 ATL6
II	Data Mining: Data Mining Functionalities – Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture OfA Typical Data Mining Systems- Classification Of Data Mining Systems. Association Rule Mining: - Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.	9	ATL3 ATL8
III	Classification and Prediction: Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section.	8	ATL3 ATL5
IV	Cluster Analysis: Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.	10	ATL2 ATL5 ATL8

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2042	DSE	DATA WAREHOUSING	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

V	Mining Object, Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.	8	ATL7 ATL8 ATL9
	Total Hours	30	

ADDITIONAL RESOURCES

A. Value addition to course content/ Skill enhancement content:

<https://www.coursera.org/specializations/data-warehousing>

B. Remedial classes for slow learners:

As per the SVVV SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

1. J. Han, M. Kamber, and J. Pei, *Data Mining: Concepts and Techniques*, 3rd ed. Waltham, MA, USA: Elsevier/Morgan Kaufmann, 2011.
2. A. Berson and S. J. Smith, *Data Warehousing, Data Mining, and OLAP*. New Delhi, India: Tata McGraw-Hill Education, 2007.

Reference Books

1. K. P. Soman, S. Diwakar, and V. Ajay, *Insight into Data Mining: Theory and Practice*. New Delhi, India: Prentice Hall of India, 2006.
2. G. K. Gupta, *Introduction to Data Mining with Case Studies*. New Delhi, India: Prentice Hall of India, 2006.
3. P.-N. Tan, M. Steinbach, and V. Kumar, *Introduction to Data Mining*. Boston, MA, USA: Pearson Education, 2007.

Suggested resources (Websites/e-books)

- 1 I. H. Witten, E. Frank, M. A. Hall, and C. J. Pal, *Data Mining: Practical Machine Learning Tools and Techniques*, 4th ed. Burlington, MA, USA: Morgan Kaufmann, 2016.

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2042	DSE	DATA WAREHOUSING	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

LIST OF PRACTICAL

	Title	CO Mapping
1.	Build and implement a data warehouse architecture using a sample dataset.	CO1
2.	Perform data extraction, cleanup, and transformation using ETL tools.	CO1
3.	Design and execute OLAP queries for multidimensional data analysis.	CO1
4.	Conduct data preprocessing, cleaning, and integration on raw data.	CO2
5.	Implement frequent item set mining and association rule mining techniques.	CO2
6.	Classify data using decision tree and Bayesian classification methods.	CO2
7.	Evaluate the accuracy and error measures of different classifiers.	CO2
8.	Apply partitioning, hierarchical, and density-based clustering methods to a dataset.	CO3
9.	Analyze multimedia and spatial data using data mining techniques.	CO3
10.	Perform text mining and web mining on real-world data sources.	CO3

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcome s	Correlation with POs												Correlation with PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	-	-	-	1	1	-	3	2	1	1
CO2	3	3	2	2	3	2	-	3	2	2	1	3	3	1	3
CO3	3	3	3	3	3	2	1	2	3	2	2	3	3	2	3

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SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2043	DSE	Ethics for Data Science	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Understand the Fundamentals of Ethics.
2. Analyze Ethical Implications of AI and Technology.
3. Apply Ethical Principles in Real-world Scenarios.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)** and **SDG 9 (Industry, Innovation and Infrastructure)**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

- CO1** Comprehend Key Ethical Concepts.
CO2 Evaluate Ethical Challenges in AI and Technology.
CO3 Implement Ethical Practices.

TEACHING PEDAGOGY:

- T1** Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2 ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

- ATL1** Quiz
ATL2 Activity Based Learning
ATL3 Midterm Exams
ATL4 Flip Class
ATL5 Seminar Presentation
ATL6 Assignments
ATL7 Poster
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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2043	DSE	Ethics for Data Science	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

ATL9 Industrial Visit Report

PREREQUISITES:

Basic Computer Knowledge

SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment Tools
I	Introduction to Ethics: What are Ethics?, History, Concept of Informed Consent, Data Ownership, Privacy, Anonymity, Data Validity, Algorithmic Fairness, Societal Consequences, Code of Ethics, Attributions.	10	ATL1 ATL4 ATL6
II	Ethics in the age of AI: Artificial Intelligence Algorithms Models and Limitations, Artificial Intelligence Data Fairness and Bias, Artificial Intelligence Privacy and Convenience, Artificial Intelligence Ethics in Action, The Complex World of Data, The Challenges & Strategies of Putting Ethics into Practice.	9	ATL2 ATL5 ATL8
III	Ethics, Technology, and Engineering – Eindhoven: Introduction, Codes of Conduct, Normative Ethics, The Ethical Cycle, Ethical Questions in the Design of Technology, Designing Morality, Ethical Aspects of Technological Risks, Distribution of Responsibility.	8	ATL4 ATL5 ATL6
IV	Data Ethics, AI, and Responsible Innovation: Getting Started and Big Data Opportunities, Big Data Limitations, Research Ethics, Law and Ethics, Crime and Justice, Home and City, Money and Markets, Life and Health.	10	ATL2 ATL8
V	Ethical Implications of Emerging Technologies: New and upcoming technologies and their potential impact on society. Ethical Challenges and Considerations, Case Studies of Emerging Technologies, Regulation and Policy, Future Directions in Technology Ethics.	8	ATL7 ATL9
Total Hours		30	

ADDITIONAL RESOURCES

A. Value addition to course content/ Skill enhancement content:

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SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2043	DSE	Ethics for Data Science	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

<https://www.coursera.org/learn/data-science-ethics>

B. Remedial classes for slow learners:

As per the SVVV SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

1. D. Raji, "How our data encodes systematic racism," *MIT Technology Review*, Dec. 10, 2020.

Reference Books

1. M. Loukides, H. Mason, and D. J. Patil, *Ethics and Data Science*. Sebastopol, CA, USA: O'Reilly Media, 2018, ch. 3, "The Five Cs."
2. M. Zook, S. Barocas, K. Crawford, E. Keller, A. Goodman, R. Hollander, B. A. Koenig, J. Metcalf, A. Narayanan, A. Nelson, and F. Pasquale, "Ten simple rules for responsible big data research," *PLOS Computational Biology*, vol. 13, no. 3, pp. 1–10, Mar. 2017.

Suggested resources (Websites/e-books)

1. American Civil Liberties Union, "Scary Pizza" [Video]. YouTube, 2004. Available: <https://www.youtube.com/watch?v=33CIVjvYyEk>. Accessed: Jun. 14, 2026.

LIST OF PRACTICAL

	Title	CO Mapping
1.	Facebook-Cambridge Analytica Scandal: This case study explores the misuse of data by Cambridge Analytica, which harvested personal data from millions of Facebook users without their consent. It raises issues of data ownership, privacy, informed consent, and the societal consequences of data misuse.	CO1
2.	COMPAS Recidivism Algorithm: This case study examines the use of the COMPAS algorithm in the US criminal justice system to predict recidivism rates. It highlights issues of algorithmic fairness, bias, and the ethical implications of using AI in decision-making processes that affect people's lives.	CO1

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SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS2043	DSE	Ethics for Data Science	Max	60	20	20	30	20	2	0	2	3
			Min	24	16		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

3.	Volkswagen Emissions Scandal: This case study discusses the ethical breaches by Volkswagen when they installed software in diesel engines to cheat emissions tests. It covers topics such as codes of conduct, normative ethics, the ethical cycle, and the distribution of responsibility in technological design.	CO2
4.	Google Street View Privacy Concerns: This case study explores the privacy issues raised by Google's Street View project, which involved capturing images of streets and homes worldwide. It addresses the balance between innovation and privacy, research ethics, and the societal impact of big data projects.	CO3
5.	CRISPR Gene Editing: This case study examines the ethical challenges and considerations surrounding the use of CRISPR technology for gene editing. It discusses the potential impact on society, regulation and policy, and the future directions in technology ethics.	CO3

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcome s	Correlation with POs												Correlation with PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	-	-	-	1	1	-	3	2	1	1
CO2	3	3	2	2	3	2	-	3	2	2	1	3	3	1	3
CO3	3	3	3	3	3	2	1	2	3	2	2	3	3	2	3

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SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS207	SEC	PYTHON FOR DATA SCIENCE LAB	Max	0	0	0	0	50	0	0	2	1
			Min	0	0	0	45					

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

- To explore the programming skills relevant to data science and to gain knowledge of various libraries and packages like NumPy, Pandas and Matplotlib required for data analysis, data visualization, natural language processing and machine learning.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4 (Quality Education)** and **SDG 9 (Industry, Innovation and Infrastructure)**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

- CO1** To understand data types in python and to apply array concepts using NumPy.
- CO2** Structuring data using NumPy and manipulating the data using Pandas.
- CO3** Using Pandas to analyze and work with data sets.
- CO4** Graphical visualization of data using Matplotlib.

TEACHING PEDAGOGY:

- T1** Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
- T2** ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

- ATL1** Quiz
- ATL2** Activity Based Learning
- ATL3** Midterm Exams
- ATL4** Flip Class
- ATL5** Seminar Presentation
- ATL6** Assignments
- ATL7** Poster
- ATL8** Oral Viva-voce examination

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			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS207	SEC	PYTHON FOR DATA SCIENCE LAB	Max	0	0	0	0	50	0	0	2	1
			Min	0	0	0	45					

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

ATL9 Industrial Visit Report

PREREQUISITES:

Programming

SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment Tools
I	Compilation v/s Interpretation: Script mode and Interactive mode · Command Line Arguments, Data Types: Numbers, string, bool, Advanced Data Types: list, tuple set, dictionary, Type casting: implicit, explicit.	10	ATL1 ATL3
II	Function: User defined function, Built in functions, Lambda Function: filter, reduce, map, reverse function, doc string, types of arguments: positional, default, keyword, variable length, variable length keyword.	9	ATL2 ATL8
III	Exception Handling: User defined exception handler, disadvantages of having single except block, grouping multiple exception in single except block, printing the default message of exception by aliasing, optional else block, propagation of exception object.	8	ATL2 ATL8
IV	File handling: Reading a file, modes of file, closing a file, context managers in python, reading file contents line by line, reading a single line in a file, reading a multiple lines in a file, reading a character in a line, readline().	10	ATL2 ATL6
V	OOPS concepts: Encapsulation, polymorphism, inheritance, abstraction, operator overloading and magical methods, multi threading in python.	8	ATL5 ATL7 ATL9
Total Hours		30	

ADDITIONAL RESOURCES

A. Value addition to course content/ Skill enhancement content:

<https://www.kaggle.com/learn/python>

B. Remedial classes for slow learners:

As per the SVVV SOP for slow and fast learners.

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS207	SEC	PYTHON FOR DATA SCIENCE LAB	Max	0	0	0	0	50	0	0	2	1
			Min	0	0		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

SUGGESTED READINGS:

Textbooks

1. J. VanderPlas, *Python Data Science Handbook: Essential Tools for Working with Data*. Sebastopol, CA, USA: O'Reilly Media, 2017.
2. M. A. Hameed, *Python for Data Science*. Hoboken, NJ, USA: Wiley, 2021.

Reference Books

1. Daniel, *Python for Data Science: The Ultimate Step-by-Step Guide to Python Programming*. Sebastopol, CA, USA: O'Reilly Media, 2021.
2. Computer Science Academy, *Python for Data Science: A Crash Course for Data Science and Analysis, Python Machine Learning and Big Data*. Independently Published, 2021

Suggested resources (Websites/e-books)

1. P. Barry, *Head First Python*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2023.

LIST OF PRACTICAL

	Title	CO Mapping
1.	Write a program to demonstrate a) Different numeric data types and b) To perform different Arithmetic Operations on numbers in Python.	CO1
2.	Write a program to create, append, and remove lists in Python.	CO1
3.	Write a program to demonstrate working with tuples in Python.	CO1
4.	Write a program to demonstrate working with dictionaries in Python.	CO1
5.	Write a program to demonstrate a) arrays b) array indexing such as slicing, integer array indexing and Boolean array indexing along with their basic operations in NumPy.	CO1,02
6.	Write a program to compute summary statistics such as mean, median, mode, standard deviation and variance of the given different types of data.	CO2,03
7.	Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first file should be the input that to be written to the second file.	CO1

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SEMESTER-II (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MTCS207	SEC	PYTHON FOR DATA SCIENCE LAB	Max	0	0	0	0	50	0	0	2	1
			Min	0	0		0	45				

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; *Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

8.	Write a program to demonstrate Regression analysis with residual plots on a given data set.	CO3,04
9.	Write a program to demonstrate the working of the decision tree-based ID3 algorithm.	CO3
10.	Write a program to implement the Naïve Bayesian classifier for a sample training data set stored as a .CSV file.	CO3,04

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcome s	Correlation with POs												Correlation with PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	3	-	-	-	1	1	-	3	2	1	1
CO2	3	3	2	2	3	2	-	3	2	2	1	3	3	1	3
CO3	3	3	3	3	3	2	1	2	3	2	2	3	3	2	3
CO4	2	3	2	-	3	2	2	1	3	3	1	3	3	3	2

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