

# **Dr. Babasaheb Ambedkar Technological University**

**(Established as University of Technology in the State of Maharashtra**

**(Under Maharashtra Act No. XXIX of 2014)**

**P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra**

**[www.dbatu.ac.in](http://www.dbatu.ac.in)**



**Under Graduate Programme**

**Bucket of Multi – Disciplinary Minor (MDM) Courses**

**In**

**Artificial Intelligence And Allied Branches**

**With effective from the academic year**

**2025 – 2026**

**(For Affiliated Institutes only)**

**Department of Computer Engineering**

# Dr. Babasaheb Ambedkar Technological University, Lonere

## Course Structure for Multi-Disciplinary Minor (MDM) Bucket in Artificial Intelligence and Allied Branches (UG) w.e.f. 2025-26 as per NEP-2020 (For Affiliated Institutes Only)

Semester	Course Code	Course Name	Teaching Scheme		Evaluation Scheme			Credit
			T	P	CA	MTE	ESE	
III	25AFAIMD306A	Artificial Intelligence	3	-	20	20	60	3
	25AFAIMDL306A	Artificial Intelligence Laboratory	-	2	60	-	40	1
	25AFAIMD306B	Prompt Engineering	2	-	20	20	60	2
	25AFAIMDL306C	Python Programming Laboratory	1	2	60	-	40	2
IV	25AFAIMD406A	Data Analytics	2	-	20	20	60	2
	25AFAIMD406B	Probability and Statistics	3	-	20	20	60	3
V	26AFAIMD506A	Machine Learning	3	-	20	20	60	3
	26AFAIMD506B	MLOps	2	-	20	20	60	2
	26AFAIMDL506B	MLOps Laboratory	-	2	60	-	40	1
VI	26AFAIMD606A	Deep Learning	3	-	20	20	60	3
	26AFAIMD606B	Natural Language Processing	3	-	20	20	60	3
VII	26AFAIMD706	Computer Vision	3	-	20	20	60	3
VIII	27AFAIMD806	AI Ethics	2	-	20	20	60	2

A student wishing to pursue a Minor program in B.Tech. (Artificial Intelligence and Machine Learning) needs to complete at least 14 credits from the list of courses.

## Second Year (Semester – III) Artificial Intelligence

25AFAIMD306A	Artificial Intelligence	<b>MDM</b>	3L-0T-2P	4 Credit
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./ week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

### COURSE CONTENT

#### **Unit I: Introduction**

What Is AI? The Foundations of Artificial Intelligence, the History of Artificial Intelligence, the State of the Art. Intelligent Agents: Agents and Environments Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

#### **Unit II: Problem-solving**

Solving Problems by Searching, Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems. Adversarial Search, Games, Optimal Decisions in Games, Alpha–Beta Pruning.

#### **Unit-III: Knowledge & Reasoning**

Knowledge representation issues, Representation & mapping, Approaches to knowledge representation, Issues in knowledge representation. Using predicate logic: Representing simple facts in logic, Representing instant & ISA relationship, Computable functions & predicates, Resolution, Natural deduction. Representing knowledge using rules: Procedural verses declarative knowledge, Logic programming, Forward verses backward reasoning, Matching, Control knowledge.

#### **Unit-IV: Probabilistic Reasoning**

Representing knowledge in an uncertain domain, The semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics, Planning: Overview, Components of a planning system, Goal stack planning, Hierarchical planning and other planning techniques.

#### **Text / Reference Books:**

1. Rich, E. and Knight K.: Artificial Intelligence, Tata McGraw- Hill.
2. Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.
3. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley.

## Second Year (Semester – III) Prompt Engineering

25AFAIMD306B	Prompt Engineering	MDM	2L-0T-0P	2 Credit
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Teaching Scheme	Examination Scheme
Lecture: 2 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

### COURSE CONTENT

#### **Unit I: Introduction to Prompt Engineering & LLMs**

Evolution of NLP to Large Language Models, Anatomy of LLMs: Tokens, embeddings, context windows, Why prompt engineering matters, Prompt engineering applications in AI/ML systems, Introduction to GPT, Claude, PaLM, Mistral, etc., Prompting vs fine-tuning.

#### **Unit II: Foundations of Prompt Design**

Types of prompting: Zero-shot, One-shot, Few-shot, Prompt patterns: Instructional, Delimiting, Role-based, Socratic, Prompt evaluation metrics: accuracy, relevance, hallucination, safety, Prompt debugging techniques.

**Advanced Prompting Techniques:** Chain-of-Thought Prompting, Self-Ask Prompting, ReAct (Reason + Act) prompting, Multimodal prompting (text + image), Prompt templates using Python APIs (LangChain, OpenAI SDK).

#### **Unit-III: Prompt Engineering for Domain-Specific Tasks**

Coding assistance and code generation prompts, Conversational agents and dialogue design, Legal, educational, medical prompts, Data wrangling and analysis via prompting, Prompting in low-resource languages.

#### **Unit-IV: Prompt Safety, Bias, and Ethics:**

Bias, toxicity, misinformation in model outputs, Adversarial prompting and jailbreak attempts, Safety best practices in prompt design, Evaluation frameworks (BLEU, ROUGE, BERTScore, human evals), Future directions: function calling, tool use, retrieval-augmented generation (RAG)

#### **Text / Reference Books:**

4. "The Art of Prompt Engineering with OpenAI APIs" by Nathan Hunter.
5. "Prompt Engineering for Everyone" by Isa Fulford & Andrew Ng (DeepLearning.AI short course).
6. "Building AI Applications with OpenAI API" by Yash Sheth.

## Second Year (Semester – III)

### Python Programming

25AFAIMD306C	Python Programming	<b>MDM</b>	1L-0T-2P	2 Credit
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Teaching Scheme	Examination Scheme
Lecture: 1 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

#### Course Objectives:

1. Understand algorithms, data structures, and core programming concepts while setting up Python and running your first programs. Work with variables, operations, control flow, functions, strings, and file handling to create interactive and robust applications.
2. Apply object-oriented programming principles and efficiently use Python's built-in collections like lists, tuples, sets, and dictionaries.
3. Use SQLite and SQL queries to store, retrieve, and manage data, including practical projects like spidering Twitter and joining multiple tables

### COURSE CONTENT

#### Unit-1

**02 hrs**

Informal introduction to programming, algorithms and data structures, downloading and installing Python, run a simple program on Python interpreter.

#### Unit-2

**02 hrs**

Variables, operations, control flow – assignments, conditionals, loops, functions: optional arguments, default values, passing functions as arguments, Statements, Expressions. Strings: String processing. Exception handling, Basic input/output, handling files.

#### Unit-3

**04 hrs**

Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.

#### Unit-4

**04 hrs**

Using Database and Structured Query Languages (SQL): SQLite manager, Spidering Twitter using a Database, Programming with multiple tables, JOIN to retrieve data.

#### Text/Reference Books:

1. Michael Urban and Joel Murach, Murach's Python Programming, Murach's Publication, 2016.
2. Charles Severance, Python for Informatics: Exploring Information, University of Michigan.
3. Dr. R. Nageswara Rao, Core Python Programming, Dreamtech Press, 1st Edition, 2016.
4. Mark Lutz, Learning Python, O'Reilly Media, 5th Edition, 2013.
5. Mark Pilgrim, Dive into Python 3, A press Publication, 2nd Edition, 2009.
6. Allen B. Downey, Think Python, O'Reilly Media, 2nd Edition, 2012.
7. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson Education, 1st Edition, 2006.

## Second Year (Semester – IV) Data Analytics

25AF1257MD406A	Data Analytics	MDM	2L-0T-0P	2 Credit
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Teaching Scheme	Examination Scheme
Lecture: 2 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

### Course Objectives:

1. Apply statistical concepts and methods for data collection, preparation, cleaning, and exploratory data analysis, addressing bias and errors.
2. Compute and interpret descriptive statistics, measures of central tendency, spread, and distribution shape to summarize datasets.
3. Perform data transformation and standardization techniques to prepare data for statistical modeling and hypothesis testing.
4. Conduct classical statistical tests, including Z-tests, t-tests, ANOVA, and non-parametric tests, to analyze and compare datasets.
5. Interpret the results of statistical analyses, assess significance, and evaluate model robustness and validity for data-driven decision-making.

### COURSE CONTENT

#### Unit-1: Statistical Data and Concepts

**07 hrs**

The statistical Methods, Misuse, Misinterpretation, and bias, Sampling and sampling size, Data preparation and cleaning, Missing data and data errors, Exploratory Data Analysis, Statistical error, Statistical Modeling, Computational Statistics, Inference, Bias, Confounding, Hypothesis testing, Types of error, Statistical significance, Confidence Interval, Power and robustness, Degrees of freedom, Non parametric analysis.

#### Unit-2: Descriptive Statistics

**05 hrs**

Counts and specific values, Measure of central tendency, Measure of spread, Measure of distribution shape, Statistical indices, Moments, Key functions, Measures of complexity and model selection.

#### Unit-3: Data Transformation and Standardization

**05 hrs**

Box-Cox and power transforms, Freeman-Tukey (square root and arcsine) transforms, Log and Exponential transforms, Logit transforms, Normal transform

#### Unit-4: Classical Tests and Contingency Tables

**07 hrs**

Goodness of fit tests: Anderson-Darling, Chi-square test, Kolmogorov-Smirnov, Ryan-Joiner, Shapiro-Wilk, Jarque-Bera, Lilliefors.

**Z-test:** Test of single mean, standard deviation known, Test of the difference between two means, standard deviation known, test for proportions.

**T-tests:** Test of single mean, standard deviation not known, Test of the difference between two means, standard deviation not known, Test of regression coefficients

#### Unit-5: Analysis of Variance and Covariance

**07 hrs**

**Variance test:** Chi square test of single variable, F-test of two variables, test of homogeneity; Wilcoxon

rank-sum/Mann-Whitney U test; Sign test.

**Contingency Tables:** Chi-square contingency table test, G contingency table test, Fisher's exact test, Measures of association, McNemar's test.

**ANOVA:** Single factor or one way ANOVA, Two factor or two-way and higher-way ANOVA, MANOVA, ANCOVA; Non Parametric ANOVA: Kruskal Wallis ANOVA, Friedman ANOVA test, Mood's median.

### **Text/Reference Books:**

1. Dr. Michael J de Smith, Statistical Analysis Handbook: A Comprehensive Guide to Statistical Concepts, Methods and Tools, The Winchelsea Press, Drumlin Security Ltd, Edinburgh, 2018 edition.
2. Douglas C. Montgomery, George C. Runger, Applied Statistics and Probability for Engineers, Sixth Edition, Wiley, 2013.
3. Dr. J. Ravichandran, Probability And Statistics For Engineers, First Edition, Wiley, 2010.
4. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. V2.1, Cambridge University Press. 2014. (free online).
5. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020, 2013.
6. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
7. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline, O'Reilly. 2014.

## Second Year (Semester –IV)

### Probability and Statistics

25AF1257MD406B	Probability and Statistics	MDM	3L-0T-0P	3 Credit
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Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

#### COURSE CONTENT

**Unit-I: Probability Theory** **10 hrs**  
 Definition of probability: classical, empirical, and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs, Examples.

**Unit-II: Random Variable and Mathematical Expectation** **6 hrs**  
 Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Joint and marginal probability distributions, Properties of expectation and variance with proofs.

**Unit-III: Theoretical Probability Distributions** **10 hrs**  
 Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson, and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

**Unit-IV: Correlation** **6 hrs**  
 Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient, Probable errors.

**Unit-V: Linear Regression Analysis** **6 hrs**  
 Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y, Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient.

#### Text / Reference Books:

1. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7<sup>th</sup> Revised and Enlarged Edition, 2016.
2. G. V. Kumbhojkar; Probability and Random Processes, C. Jamnadas and Co., 14th Edition, 2010.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2010.
5. G. Haribaskaran; Probability, Queuing Theory and Reliability Engineering, Laxmi Publications, 2nd Edition, 2009.
6. Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability And Statistics, Schaum's Outlines, 4th Edition, 2013.