

GANPAT UNIVERSITY										
FACULTY OF ENGINEERING & TECHNOLOGY										
Programme	Bachelor of Technology				Branch/Spec.			Civil Engineering		
Semester	I				Version			1.0.0.0		
Effective from Academic Year	2026-27				Effective from the batch admitted in			July 2026		
Course Code	2PCC-CI-1101				Course Name			Essentials of Data Sciences and AI for Civil Engineers		
Course Category	Professional Core Courses (PCC)									
Teaching & Learning Scheme							Examination scheme (Marks)			
	L	TU	P	Total	SL	TSL		CE	SEE	Total
Credit	2	0	1	3	30	90	Theory	50	50	100
Hours (per week)	2	0	2	4			Practical	25	25	50
L: Lecture, TU: Tutorial, P: Practical/Lab., SL: Minimum Self-Learning or Term Work Hours per Semester, TSL: Minimum Total Teaching & Self-Learning Hours per Semester, CE: Continuous Evaluation, SEE: Semester End Examination.										
Pre-requisites:										
Not Applicable										
Course Outcomes										
COs	Description									
CO1	Explain the fundamentals of Data Science, Artificial Intelligence, and Machine Learning, and describe their significance, data lifecycle, and applications in civil engineering problems.									
CO2	Apply Python programming concepts and data handling tools such as NumPy and Pandas to analyze civil engineering data and perform exploratory data analysis using statistical methods.									
CO3	Develop data visualizations and machine learning models using supervised and unsupervised learning techniques to solve real-world civil engineering applications.									
CO4	Analyze advanced AI and deep learning techniques, emerging tools, and future trends to support intelligent decision-making, sustainability, and innovation in civil engineering practice.									
Theory Syllabus										
Unit	Content									Hours
1	Fundamentals of Data Science, AI/ML and Programming for Civil Engineers: Overview of Need and significance of DS, AI/ML in Civil Engineering, Understanding Data Science, Basics of AI and Machine Learning, Types of Machine Learning, Role of Data in ML and Machine Learning Project Life Cycle, The Importance of Data Science and AI in Civil Engineering. Python for Civil Engineers, Getting Started with Jupiter, Data Types, Expressions and Variables Conditions, Branching and Loops, Functions, Objects and Classes, Data Types in Construction Industry, Data Structures: Lists & Tuples, Dictionaries & Sets Exploratory Data Analysis (EDA), Statistical Methods: Mean, Median, Variance, Various phases of EDA in DS/AI/ML									6
2	Data Handling and Visualization using Python Tools for Civil Engineers: NumPy Library: Creating Arrays, Accessing Array Elements, Operations on Arrays; Pandas Library: Creating & Accessing Series Elements, Selecting Data from Data Frame, Setting Values into Data Frame, Missing values & Pivot Table; Construction Site Work Analysis with NumPy, Construction Project Cost Analysis with Pandas, Traffic Flow Analysis in a city using NumPy and Pandas Visualization Concepts, Plot Libraries in Python, Matplotlib: Simple Line Plots & Area Plots, Bar Charts & Pie Charts, 2D & 3D Contour Plots; Introduction to Seaborn, Seaborn: Histograms & Box Plots, Scatter Plots & Bubble Plots, Heatmaps, Pair plots & Radar Plots; Plotly & Dash: Interactive Dashboards and Maps.									6
3	ML Algorithms – Supervised & Unsupervised Learning Techniques in Civil Engineering Applications:									6

	Core Machine Learning Concepts in Civil Engineering, Supervised Learning Techniques Regression Concepts & its types (Add Metrics), Linear Regression Model, Regularization Techniques, Non-linear Regression Model Supervised learning classification Concepts - Types of Classifier, Measures/ Metrics of Classification, KNN-Algorithms, SVM, Naive Bayes, Decision Trees, Ensemble Learning, Boosting and Bagging, Random Forest Unsupervised Learning Techniques, Clustering Methods, Association Rule Mining, Introduction to Dimensionality Reduction, Principal Component Analysis (PCA)	
4	Deep Learning and AI Model tools for Civil Engineers: Introduction to Deep Learning, Tensorflow & Keras Neural Networks Basics, Artificial Neural Networks (ANNs), Perceptron and Multi-Layer Perceptron (MLP), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs). Reinforcement learning, Genetic Algorithms Vs Traditional Algorithms, Fuzzy logic and Fuzzy relations, Fuzzy Rules and decision making, Traffic signs and Traffic analysis use cases. Developing and Enhancing Custom ML Tools with a GUI, Model Fine-Tuning and Customization, Testing and Debugging Machine Learning Tools, Evaluating Model Performance and Optimization, Innovations Google Colab, Teachable Machine (by Google)	6
5	AI Techniques and Future Directions in Civil Engineering: Data Integration, Predictive Analytics (Equipment Maintenance), Descriptive Analytics (Traffic Patterns), Prescriptive Analytics (Project Management), Real-time Safety Monitoring, Risk Forecasting and Water Quality Assessment. Selection Strategies for DS and AI. Future Trends: Introduction to IOT in Construction, Intelligent Parking systems, Smart lighting systems, Disaster Deduction/Management, Smart solid Waste Management, Smart irrigation systems, Smart Air Quality monitoring Prompt Engineering, Human-Centered AI in Civil Engineering, Quantum Computing, Policy Implications.	6

Practical and Self Learning Content

Practical, assignments, quiz, industrial visit, and tutorials are based on the above syllabus.

Text Books

1	Data Science for Engineers and Scientists by Julie Bergner and Nicholas Czarnecki
2	Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig

Reference Books

1	Data Science for Civil Engineering: Structures and Applications" by Khaled Shahata
2	Understanding Machine Learning: From Theory to Algorithms- Shai Shalev-Shwartz and Shai Ben-David
3	Artificial Intelligence in Civil Infrastructure: Applications and Future Directions edited by M. Shabbir Ahsan, Zachary G. Grasley, and Mark F. Teply
4	Artificial Intelligence and Machine Learning Techniques for Civil Engineering (Advances in Civil and Industrial Engineering) by Vagelis Plevris, Afaq Ahmad, Nikos D. Lagaros.
5	Software Engineering: A Practitioner's Approach" by Roger S. Pressman.

ICT/MOOCs Reference

1	E-learning content on L&T EduTech Platform
2	Journals Related to AI/ML in Civil Engineering Domains

Mapping of COs, POs, and PSOs														
COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	0	3	2	2	0	0	0	0	2	2	3	2
CO2	3	2	1	2	3	2	0	1	0	0	3	3	3	2
CO3	2	3	2	2	3	2	0	1	1	0	3	3	3	3
CO4	2	3	2	1	3	3	1	0	0	1	3	3	3	3

Bloom's Taxonomy Level				
Unit	Unit Title	Aligned COs	Learning Hours	BTL Level
1	Fundamentals of Data Science, AI/ML and Programming for Civil Engineers	CO1	10	N
2	Data Handling and Visualization using Python Tools for Civil Engineers	CO2	7	N
3	ML Algorithms – Supervised & Unsupervised Learning Techniques in Civil Engineering Applications	CO3	10	N
4	Deep Learning and AI Model tools for Civil Engineers	CO4	8	N
5	AI Techniques and Future Directions in Civil Engineering	CO4	10	E

Note:

- Version 1.0.0.0 (First Digit= New syllabus/Revision in Full Syllabus, Second Digit=Revision in Teaching Scheme, Third Digit=Revision in Exam Scheme, Forth Digit= Content Revision)
- 1 Hour Lecture = 1 Credit, 1 Hour Tutorial = 1 Credit, 2 Hours Practical = 1 Credit, 2 Hours Internship/Project/Seminar = 1 Credit
- As per NCrF/NEP 2020, Minimum Self-Learning or Term Work Hours per Semester should be calculated in such a way that 1 Credit should have minimum 30 Hours of Teaching and Self Learning Engagement per semester
- Bloom's Taxonomy Level (BTL) : R: Remember, U: Understand, A: Apply, N: Analyze, E: Evaluate, and C: Create