

INSTITUTE	FACULTY OF TECHNOLOGY
PROGRAM	BACHELOR OF TECHNOLOGY (CIVIL ENGINEERING)
SEMESTER	6
COURSE TITLE	INTRODUCTION TO AIOT IN CIVIL ENGINEERING
COURSE CODE	01CI0625
COURSE CREDITS	3

Objective:

- 1 Introduce the fundamental concepts of Artificial Intelligence (AI), Internet of Things (IoT), and their integration in civil engineering applications
- 2 Familiarize students with emerging tools, technologies, and platforms for AIoT-enabled smart infrastructure and construction.
- 3 Develop analytical, problem-solving, and design skills through real-world civil engineering case studies using AIoT
- 4 Enable students to apply AIoT concepts for monitoring, automation, and optimization in structural, geotechnical, environmental, and transportation systems
- 5 Encourage creativity and critical thinking for sustainable and smart solutions in civil engineering

Course Outcomes: After completion of this course, student will be able to:

- 1 Apply AIoT-based data acquisition and sensing techniques to monitor structural and environmental parameters in civil engineering projects.
- 2 Analyze real-time data from AIoT systems to identify patterns, anomalies, and performance trends in construction and infrastructure.
- 3 Evaluate the effectiveness of AIoT-enabled solutions for improving safety, sustainability, and efficiency in civil engineering applications
- 4 Design simple AIoT workflows integrating sensors, networks, and AI algorithms for specific civil engineering problems such as structural health monitoring or smart construction management.
- 5 Create prototype models or case studies demonstrating AIoT applications in areas like smart cities, intelligent transportation systems, or green construction technologies.

Pre-requisite of course: Knowledge of Civil Engineering courses from semester 1 to 5 and orientation to programming languages. Preliminary information of sensors, internet technology, digital gadgets etc.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
2	1	0	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Fundamentals of AIoT in Civil Engineering Evolution of AI and IoT, convergence into AIoT, relevance to civil engineering domains (construction, transportation, smart cities, environment).	2
2	Sensors, Devices, and Data Acquisition Civil engineering sensors (structural, geotechnical, environmental), IoT hardware (Arduino, Raspberry Pi, ESP32), wireless protocols (LoRa, ZigBee, Wi-Fi, 5G).	4
3	Data Transmission, Storage, and Edge Computing Cloud vs. edge vs. fog computing, data storage solutions, cyber-security in AIoT.	2
4	Basics of AI and Machine Learning for Civil Engineers Supervised/unsupervised/reinforcement learning, pre-processing & feature extraction, simple models (regression, clustering, decision trees).	4
5	AIoT for Structural Health Monitoring (SHM) Vibration, strain, displacement monitoring, anomaly detection, SHM case studies.	4
6	AIoT in Smart Construction & Project Management Real-time progress tracking, resource optimization, worker safety monitoring.	2
7	AIoT in Transportation & Smart Cities Traffic monitoring & control, intelligent transport systems, smart city integration.	2
8	AIoT for Sustainability & Green Infrastructure Energy-efficient construction, waste reduction & recycling tracking, carbon footprint monitoring.	2
9	System Design & Prototyping with AIoT Workflow integration (sensors - data - AI model - decisions), prototyping with MATLAB, Python, Node-RED.	4
10	Case Studies, Emerging Trends & Project Presentations International best practices, digital twins, autonomous infrastructure, student projects.	2
Total Hours		28

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Tutorial-1 Exploring AIoT Applications in Civil Engineering Brainstorm in groups to identify 5 possible AIoT applications in civil projects; present short notes.	1
2	Tutorial-2 Hands-on with Civil Engineering Sensors Demonstrate use of strain/vibration sensor or virtual simulation; students record data and interpret readings.	1

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
3	Tutorial-3 IoT Hardware Demo Assemble a basic IoT kit (Arduino/ESP32) and configure it to log dummy sensor data.	1
4	Tutorial-4 Data Flow in AIoT Draw and explain a workflow: sensor - transmission - storage - analysis for a civil engineering case.	1
5	Tutorial-5 Preprocessing Civil Data Given a sample dataset (traffic, structural loads, weather), students clean and normalize data.	1
6	Tutorial-6 Simple ML Model Run regression/clustering in Excel/Python for predicting load or traffic patterns; interpret output.	1
7	Tutorial-7 AIoT in SHM Case discussion on a bridge or building using SHM sensors; identify anomalies from sample data.	1
8	Tutorial-8 Real-time Monitoring Simulation Use a dashboard (MATLAB/ThingSpeak/Node-RED) to visualize real-time sensor readings.	1
9	Tutorial-9 AIoT in Construction Analyze a scenario of worker safety monitoring; propose a workflow of devices + AI.	1
10	Tutorial-10 Smart City Application Group exercise: design an IoT system for traffic congestion reduction in an urban setting.	1
11	Tutorial-11 Sustainability with AIoT Calculate carbon footprint tracking using given dataset; suggest AIoT-based improvements.	1
12	Tutorial-12 Prototype Workflow Build a mini workflow (simulation only) integrating data collection and simple AI analysis.	1
13	Tutorial-13 AIoT Mini-Project Design Teams prepare a concept note of a small project (e.g., smart pavement, intelligent drainage).	1
14	Tutorial-14 Project Presentations & Peer Review Students present mini-projects; peers evaluate based on innovation and feasibility.	1
Total Hours		14

Textbook :

- 1 Introduction to Internet of Things in Civil Engineering, Ankur Bhogayata & Amit Sata, Springer, 2024

References:

- 1 Artificial Intelligence with Python for Beginners, Artificial Intelligence with Python for Beginners, Himanshu Sharma, Apress, 2020

Suggested Theory Distribution:

The suggested theory distribution as per Bloom’s taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
5.00	5.00	30.00	30.00	20.00	10.00

Instructional Method:

- 1 Problem-Based Learning (PBL)
- 2 Problem-Based Learning (PBL)
- 3 Simulation & Demonstration-Based Learning
- 4 Collaborative MiniProjects
- 5 Flipped Classroom with Guided Discussions

Supplementary Resources:

- 1 <https://www.digi.com/blog/post/iot-in-construction#:~:text=concerns%20in%20construction.-,Security,cybersecurity%20of%20their%20connected%20devices.>
- 2 <https://prezi.com/p/mcr-agtmmupd/impact-of-iot-in-civil-engineering/>
- 3 https://www.e3s-conferences.org/articles/e3sconf/pdf/2021/85/e3sconf_icmed2021_01209.pdf
- 4 <https://aws.amazon.com/what-is/iot/#:~:text=The%20term%20IoT%2C%20or%20Internet,as%20between%20the%20devices%20themselves.>