III B.Tech II Semester

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23A39605	**EDGE COMPUTING LAB (Professional Core)**	**0**	**0**	**3**	**1.5**

Course Objectives:

- To impart practical knowledge of edge computing architecture and frameworks.
- To provide hands-on experience in deploying AI and IoT applications on edge devices.
- To explore edge-native computing environments like Raspberry Pi, Jetson Nano, etc.
- To introduce performance analysis, optimization, and energy efficiency in edge computing.
- To understand data preprocessing, model deployment, and real-time inferencing on the edge.

Course Outcomes:

- Students will be able to practically implement edge computing applications using real-world platforms and tools.
- Students gain experience in deploying lightweight ML models on edge devices, manage data flow between edge and cloud, and ensure system performance under limited computing and networking resources.
- Students will understand how to optimize latency, power consumption, and reliability of edge solutions for smart environments.

List of Lab Experiments:

1. Setup and Configuration of Edge Devices
    - Raspberry Pi/Jetson Nano installation, SSH, GPIO control
2. Data Acquisition from Sensors
    - Reading data from temperature, motion, and environmental sensors
3. Deploying a Lightweight ML Model on Edge
    - Using TensorFlow Lite or PyTorch Mobile for deployment
4. Real-Time Image Classification at the Edge
    - Using camera module with edge device for inference
5. MQTT-Based Edge Communication
    - Setup publisher/subscriber model for edge-to-cloud communication
6. Integrating Edge Devices with Cloud Platforms
    - AWS IoT, Azure IoT Hub, or Google Cloud IoT integration
7. Edge Device Power and Latency Monitoring
    - Measuring latency and energy consumption during model inference
8. Edge AI Application – Smart Surveillance System
    - Face or object detection on live video stream using OpenCV
9. Streaming Data Analytics on Edge
    - Local aggregation and event processing with Kafka or lightweight alternatives
10. Model Optimization for Edge Deployment

11. Quantization, pruning, and compression for reducing model size
    TinyML for Microcontroller-Based Inference

12. Deploy a model on Arduino/Nano BLE using TensorFlow Lite Micro
    Edge-Orchestrated Federated Learning Prototype

- Basic FL setup using two edge devices sharing a model

Text Books:

1. Perry Lea, Edge Computing: From Hype to Reality, Manning Publications.
2. Satyanarayana G. et al., Edge Analytics with Raspberry Pi, Springer.
3. Arun Kumar Sangaiah et al., Edge Computing and Computational Intelligence Paradigms for the IoT, Elsevier.

Reference Books:

1. Flavio Bonomi, Fog and Edge Computing: Principles and Paradigms, Wiley.
2. Preetha Evangeline, IoT and Edge Computing for Architects, Packt Publishing.
3. Rajkumar Buyya, Internet of Things and Edge Computing for Smart Environments, Springer.

Online Courses:

1. Edge AI and Computer Vision – Udacity (NVIDIA)
2. **AI on the Edge with Raspberry Pi – Coursera**