GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering
Level: PG
Branch: Information Technology
Subject Code : ME02023061
Subject Name : Edge Computing

w. e. f. Academic Year:	A.Y. 2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Cloud Computing, Fog computing, Computer Network
Rationale:	The course introduces students to edge computing, an important branch of distributed computing and IoT with significant applications. This course aims to provide an in-depth and comprehensive knowledge of the Edge Computing fundamental, technologies, applications, challenges, security issues, and implementations.

Course Outcome: To provide
After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	Articulate key concepts, technologies, strengths, and limitations of edge computing and the possible applications for state-of-the-art edge computing	U
2	Identify challenges associated with edge networks	U
3	Able to analyze an edge ecosystem and identify areas of improvement, demonstrating knowledge of edge-computing architectures and their constituents.	N
4	Conceptualize and model a basic edge-based solution incorporating security considerations in line with business requirements.	E

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction** • Fundamentals of Edge Computing • Core concepts of Distributed systems and Edge computing • Edge computing architectures	5	10

	• Roles and Functions of Edge Communication Technologies • Types of IoT devices and Sensors in edge computing • Edge computing vs cloud computing vs fog computing		
2.	• Edge Computing Networks and interfaces • Network topologies and connectivity • Edge servers and other devices • Applications of Edge Networks in Modern Industries • Challenges in Edge Networks	4	10
3	• Introduction to Edge Data Center, Lightweight Edge Clouds and its services provided by different service providers. • Introduction to MQTT and Kafka for end-to-end edge pipeline. Edge analytics topologies for M2M and WSN network (MQTT)	5	13
4	• Types of data analytics • Core tenets of edge analytics • Optimization and modelling frameworks • Artificial intelligence, machine learning, and deep learning at the Edge Computing.	4	10
5.	**Autonomic management and orchestration** • Network advancements in Edge Computing • Slicing in 5G technologies - Mobile edge computing • Network slicing • Slicing in Software-defined Clouds • Slicing management in Edge computing	5	11
6.	• Edge computing in Industry 4.0 • IoT service architectures and devices • Intelligent IoT applications	4	12
7.	• Infrastructure and Application Security in Edge Computing • Threat modelling and common security issues • Physical and device-level security • Logical security in Edge Computing • Application security in Edge Computing	5	12
8.	• Privacy and Data Security in Edge Computing • Data confidentiality, security and privacy • Identity management in edge computing • Essential Security Protocols for Edge Networks	5	11
9.	• Industrial IoT (IIoT) • Industrial Edge • IIoT and digital transformation across Industry 4.0 sectors • IIoT devices, platforms, and networks • Smart machines • Smart Factory architectures and protocols	5	12

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
-	**30**	**30**	**20**	**20**	**---**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:
(a) Books:

1. "Fog and Edge Computing: Principles and Paradigms", Rajkumar Buyya (Editor), Satish Narayana Srirama (Editor), Wiley, 2019
2. "Edge Computing", Ajit Singh, Shroff Publishers, 2019.
3. "IoT and Edge Computing for Architects", Perry Lea, Packt publishers, 2020.
4. "Making Sense of Edge Computing", Cody Bumgardner, Caylin Hickey.
5. Taheri J. & Deng S. (eds.): "Edge Computing: Models, technologies and applications", IET, 2020
6. Sabella D., Reznik A., Frazao R., "Multi-access Edge Computing in Action", 1st edition, Kindle, 2019
7. Al-Turjman F. (ed.): "Edge Computing: from hype to reality", Springer, 2019
8. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier – 2012.
9. Tim Mather, SubraKumaraswamy, and ShahedLatif, Cloud Security and Privacy an Enterprise Perspective on Risks and Compliance, O'Reilly 2009.

(b) Online Resources:

1. NPTEL Course: https://onlinecourses.nptel.ac.in/noc24_cs66/preview
2. Edge Computing: Vision and Challenges https://cse.buffalo.edu/faculty/tkosar/cse710_spring19/shi-iot16.pdf
3. Coursera : https://www.coursera.org/learn/security-at-the-edge-first-course-1
4. Udemy : https://www.udemy.com/course/edge-computing-a-complete-guide-on-computing-at-the-edge/?couponCode=NVDIN35

Suggested Course Practical List: (List can be change according to Latest Development)

➔ Require Hardware kit: commercial off-the-shelf ARM SoC FPGA boards/Raspberry PI and IoT sensors

Sr	Aim

1	Connect LED with Board Write a program to turn on LED.
2	Developing Linux Programs that Communicate with Bluetooth Low Energy (BLE)
3	Connect an ARM Cortex-A9 System with Linux OS. Developing Linux Programs that Communicate with Wifi
4	Connect different sensors, read data, display data and process data. Transmit to cloud server.
5	Perform Audio/video processing with CNN with and without feature extractions on ARM Processor.
6	Build a basic IoT system which includes edge computations. Perform experiment and display result.
7	Apply machine/deep learning alogorithm for edge connected IoT devices for image processing.
8	Evaluate and analyze different types of IoT services and applications with respect to security and privacy issues. Case Study.

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