GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Artificial Intelligence and Data Science

Subject Code: ME02095071

Course/Subject Name: Cloud & Edge Computing Systems

WEF Academic Year	2024-25
Semester	2
Category of the Course	Professional Elective Course

Prerequisite:	Computer Network Systems and Services, Distributed Systems.
Rationale	In this course we will look at modern cloud computing environments. We start by studying how data centres are constructed, paying particular attention to data center networking. Building on this, we define cloud computing and investigate how computation can be scaled in cloud environments. We extend the notion of cloud computing to edge computing which includes devices at or near the edge of the network and learn how they can be leveraged in a combined edge-cloud-environment.

Course Outcome:

After completion of the Course, Students will be able to:

No	Course Outcomes	RBT Level*
01	Understand the concepts of cloud computing and edge computing with key technologies, strengths, limitations and the possible applications.	UN
02	Apply the cloud computing solutions in different to the applications.	AP
03	Formulate and solve the cloud and edge computing problem for real time IoT applications.	AP
04	Analyse different use cases and techniques for Edge computing.	AN
05	Evaluate the different real time applications by using RaspberryPi and computing environment.	EL

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

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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)	
03	00	02	04	70	30	20	30	150

Course Content:

Unit	Course Content	No of Hours	% of Weightage
1.	Introduction of Cloud Computing: History of Centralized and Distributed Computing, Introduction to Cloud Computing- Cloud issues and challenges, Service models, Deployment models. Cloud resources: Network and API, Virtual and Physical computational resources, Cloud Data-storage, Virtualization concepts: Types of Virtualizations, Introduction to Various Hypervisors, High Availability using Virtualization, Moving VMs.	04	10
2.	Cloud Programming and Software Environments: Web services, Web 2.0, Web OS, Anything as a service (XaaS), Parallel and Distributed Programming paradigms – Programming on Amazon AWS, Microsoft Azure, Google App Engine and Emerging Cloud software Environment, Cloud Access: authentication, authorization and accounting - Cloud Provenance and meta-data - Cloud Reliability and fault-tolerance - Cloud Security, privacy, policy and compliance- Cloud federation, interoperability and standards.	10	25
3.	RaspberryPi: Introduction to RaspberryPi, RaspberryPi Board: Hardware Layout and Pinouts, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi, Connecting Raspberry Pi via SSH, Remote	07	15

	access tools, Interfacing DHT Sensor with Pi, Pi as Webserver, Pi Camera, Image & Video Processing using Pi, Implementation of Microcomputer RaspberryPi and device Interfacing, Edge to Cloud Protocols, MQTT, MQTT publish-subscribe, MQTT architecture details, MQTT state transitions, MQTT packet structure, MQTT data types, MQTT communication formats, MQTT working example, Edge computing with RaspberryPi.		
4.	Introduction of IoT and Edge Computing: Edge Computing Scenario's and Use cases, Edge computing purpose and definition, Edge computing hardware architectures, Edge platforms, Edge vs. Fog Computing, Communication Models - Edge, Fog and M2M.	12	25
5.	IoT Architecture and Core IoT Modules: A connected ecosystem, IoT versus machine-to-machine versus SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding and Implementations with examples - Example use case and deployment, Various Case studies of IoT Based systems, requirements and implementation	12	25
	TOTAL	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**20**	**20**	**20**	**20**	**10**

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

Reference/Suggested Learning Resources:

(a) Books:

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Latest Edition, Elsevier.
2. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806.
3. Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc., 2019, ISBN: 978149204322.
4. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, Wiley publication, 2019, ISBN: 9781119524984.
5. David Jensen, "Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE
6. Barrie Sosinsky, "Cloud Computing Bible" John Wiley & Sons, 2010
7. Tim Mather, Subra Kumaraswamy, and Shahed Latif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly 2009

(b) Open source software and website

- Course-related online MOOCs on NPTEL/SWAYAM platform.
- Recently Published papers/articles in reputed journals.

Suggested Course Practical List:

- The practical work will be carried out based on the content covered during the academic sessions**.**

List of Laboratory/Learning Resources Required: Programming development environment (open source is encouraged) related to the course content.

Suggested Project List: The subject teacher has to assign the relevant project work to the students in individual/team.

Suggested Activities for Students: The subject teacher has to assign the outcome based activities to the students in individual/team.

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