**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**
**WORK INTEGRATED LEARNING PROGRAMMES**
**Digital Learning**

## Part A: Course Design

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|---|---|
| **Course Title** | Edge Computing |
| **Course No(s)** | SE ZG586/ SS ZG586 |
| **Credit Units** | 5 |
| **Content Authors** | Chandra Shekar RK |
| **Version** | 1.0 |

### Course Description

Introduction, What Is Edge Computing, Why Do We Need Edge Computing, Key Techniques that Enable Edge Computing, Definition, Benefits, Edge Computing Systems, Multi Access Edge Computing, To Edge or Not to Edge, The Cloud Part of MEC, The Edge Part of MEC, The Access Part of MEC, Challenges and Opportunities in Edge Computing, Service Management, Privacy and Security, Application Distribution, Edge Computing Tools, Virtualization, Resource Management, Edge Analytics, Conceptual Framework for Security and Privacy in Edge Computing, Overview of Security, Privacy, and Threats in Edge Computing, Framework for Security and Privacy in Edge Computing, case study and use cases

### Course Objectives

| **The course aims at:** | |
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| **CO1** | Introducing the Edge computing and need for edge computing |
| **CO2** | Developing understanding about the architecture, design of edge computing and its benefits over cloud computing |
| **CO3** | Exploring the Multi-access edge computing and its challenges and benefits |
| **CO4** | Developing understanding about Security, Privacy and threats in Edge computing |

### Text Book(s)

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|---|---|
| **T1** | Edge Computing: A Primer, Jie Cao • Quan Zhang • Weisong Shi, Springer |
| **T2** | Multi-Access Edge Computing in Action, Dario Sabella, Alex Reznik, Rui Frazao, CRC press |
| **T3** | Edge Computing Reference Architecture 2.0<br>http://en.ecconsortium.net/Lists/show/id/82.html |

### Reference Book(s) & other resources

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|---|---|
| **R1** | **Edge Computing from Hype to reality, Fadi Al Turjman,** |
| **R2** | |
| **R3** | |

**Learning Outcomes:**

| **Students will :** | |
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| **LO1** | Get an overview of Edge computing, its architectures and advantages |
| **LO2** | Appreciate the necessity and usage of edge computing in different domains |
| **LO3** | Appreciate the need for security in Edge computing |
| **LO4** | Recognize the role of edge computing involving multiple access points |

## Part B: Course Handout

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| **Academic Term** | First Semester 2021-2022 |
| **Course Title** | Edge Computing |
| **Course No** | SE ZG586/ SS ZG586 |
| **Lead Instructor** | CHANDRA SHEKHAR RK |

**Glossary of Terms**

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| **Module** | **M** | Module is a standalone quantum of designed content. A typical course is delivered using a string of modules. M2 means module 2. |
| **Contact Hour** | **CH** | Contact Hour (CH) stands for an hour long live session with students conducted either in a physical classroom or enabled through technology. In this model of instruction, instructor led sessions will be for 32 CH. |
| **Recorded Lecture** | **RL** | RL stands for Recorded Lecture or Recorded Lesson. It is presented to the student through an online portal. A given RL unfolds as a sequences of video segments interleaved with exercises. |
| **Lab Exercises** | **LE** | Lab exercises associated with various modules |
| **Self-Study** | **SS** | Specific content assigned for self-study |
| **Homework** | **HW** | Specific problems/design/lab exercises assigned as homework |

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## Modular Structure

**Module Summary**

| No. | Content of the Module |
|---|---|
| M1 | Introduction<br>1.1 What Is Edge Computing<br>1.1.1 Why Do We Need Edge Computing<br>1.1.2 Key Techniques that Enable Edge Computing<br>1.1.3 Edge Computing Definition<br>1.1.4 Edge Computing Benefits<br>1.1.5 Edge Computing Systems |
| M2 | Edge Computing Reference Architecture<br>2.1 Model-Driven Reference Architecture<br>2.2 Multi-View Display<br>2.3 Concept View<br>2.3.1 ECNs, Development Frameworks, and Product Implementation<br>2.3.2 Edge Computing Domain Models<br>2.4 Function View<br>2.4.1 ECN<br>2.4.2 Service Fabric<br>2.4.3 CCF<br>2.4.4 Development Service Framework (Smart Service)<br>2.4.5 Deployment Operation Service Framework (Smart Service)<br>2.4.6 Management Service<br>2.4.7 Full-Lifecycle Data Service<br>2.4.8 Security Service<br>2.5 Deployment View |
| M3 | Challenges and Opportunities in Edge Computing<br>3.1 Programmability<br>3.2 Naming<br>3.3 Data Abstraction<br>3.4 Service Management<br>3.5 Privacy and Security<br>3.6 Application Distribution<br>3.7 Scheduling Strategies<br>3.8 Business Model |
| M4 | Existing Edge Computing Tools<br>4.1 What Is Your Role in Edge Computing?<br>4.2 Virtualization<br>4.2.1 Virtual Machine and Container<br>4.2.2 Network Virtualization<br>4.3 Resource Management<br>4.3.1 Kubernetes and Docker |

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| | 4.4 Developing Platforms for Edge Computing<br>4.4.1 Edge Analytics<br>4.4.2 Development Tools and Platforms |
| M5 | A Conceptual Framework for Security and Privacy in Edge Computing<br>5.1 Introduction<br>5.2 Similarities and Differences Between Edge Paradigms<br>5.3 Overview of Security, Privacy, and Threats in Edge Computing<br>5.4 Framework for Security and Privacy in Edge Computing |
| M6 | Multi Access Edge Computing<br>6.1 To Edge or Not to Edge<br>6.2 The Cloud Part of MEC<br>6.3 The Edge Part of MEC<br>6.4 The Access Part of MEC<br>6.4.1 Real-Time Data Processing<br>6.4.2 SLAs and Regulatory Requirements |
| M7 | MEC Use Cases and Service Scenarios<br>7.1 Intelligent Video Acceleration<br>7.2 Video Stream Analysis<br>7.3 Augmented Reality<br>7.4 Assistance for Intensive Computation<br>7.5 MEC in the Enterprise Setting<br>7.6 Connected Vehicles<br>7.7 IoT Gateway<br>7.7.1 Public Edge Clouds |

**Experiential Learning Component**

| Lab | Topic | Description | |
|---|---|---|---|
| 1 | | | • TBA |
| 2 | | | • TBA |
| 2 | | | • TBA |
| 4 | | | • TBA |
| 5 | | | • TBA |

| | | | |
|---|---|---|---|
| 6 | | | • TBA |
| 7 | | | • TBA |

**Evaluation Scheme**:

Legend: EC = Evaluation Component; AN = After Noon Session; FN = Fore Noon Session

| No | Name | Type | Duration | Weight | Day, Date, Session, Time |
|---|---|---|---|---|---|
| **EC-1** | Quiz – 1 & 2 | Take Home | 2 days | 10% | TBA |
| | Experiential learning Assignment-I | Take Home | 15 days | 20% | TBA |
| **EC-2** | Mid-Semester Test | Open Book | 2 hours | 30% | Sunday, 26/09/2021 (FN) 10 AM - 12 Noon |
| **EC-3** | Comprehensive Exam | Open Book | 2 hours | 40% | Sunday, 14/11/2021 (FN) 10 AM - 12 Noon |

Syllabus for Mid-Semester Test (Open Book): Topics in Session Nos. 1 to 8
Syllabus for Comprehensive Exam (Open Book): All topics (Session Nos. 1 to 16)

**Important links and information:**
Elearn portal: https://elearn.bits-pilani.ac.in
Students are expected to visit the Elearn portal on a regular basis and stay up to date with the latest announcements and deadlines.
Contact sessions: Students should attend the online lectures as per the schedule provided on the Elearn portal.
Evaluation Guidelines:

1. EC1 consists of two Quiz and one assignment. Announcements will be made available on the portal, in a timely manner.
2. For Closed Book tests: No books or reference material of any kind will be permitted.
3. For Open Book exams: Use of books and any printed / written reference material (filed or bound) is permitted. However, loose sheets of paper will not be allowed. Use of calculators is permitted in all exams. Laptops/Mobiles of any kind are not allowed. Exchange of any material is not allowed.
4. If a student is unable to appear for the Regular Test/Exam due to genuine exigencies, the student should follow the procedure to apply for the Make-Up Test/Exam which will be made available on the Elearn portal. The Make-Up Test/Exam will be conducted only at selected exam centres on the dates to be announced later.

It shall be the responsibility of the individual student to be regular in maintaining the self-study schedule as given in the course handout, attend the online lectures, and take all the prescribed evaluation components such as Assignment/Quiz, Mid-Semester Test and Comprehensive Exam according to the evaluation scheme provided in the handout.