



UNIVERSIDAD  
POLITÉCNICA  
DE MADRID



## LEARNING GUIDE

# NETWORKS, APPLICATIONS AND CONTENT

MÁSTER EN INGENIERÍA DE TELECOMUNICACIÓN

|                                    |                                          |        |         |            |                 |
|------------------------------------|------------------------------------------|--------|---------|------------|-----------------|
| ACADEMIC YEAR                      | CODE                                     | COURSE | CREDITS | TYPE       | SEMESTER        |
| 2026-27                            | 93001375                                 | 1      | 5 ECTS  | COMPULSORY | SECOND SEMESTER |
| LANGUAGE                           | ASSIGNED CENTER                          |        |         |            |                 |
| ENGLISH,<br>SPANISH                | E.T.S. DE INGENIEROS DE TELECOMUNICACION |        |         |            |                 |
| ASSIGNED DEPARTMENT                |                                          |        |         |            |                 |
| INGENIERÍA DE SISTEMAS TELEMÁTICOS |                                          |        |         |            |                 |

## COORDINATOR

MANUEL ÁLVAREZ-CAMPANA FERNÁNDEZ-CORREDOR - manuel.alvarez-campana@upm.es

## REQUIRED PREREQUISITES

REQUIRED COURSES

—

## RECOMMENDED PRIOR KNOWLEDGE

RECOMMENDED COURSES

—

OTHER RECOMMENDATIONS

—

## RESULTS

RD-822/2021

### Competences

- CE7** Capacidad para realizar la planificación, toma de decisiones y empaquetamiento de redes, servicios y aplicaciones considerando la calidad de servicio, los costes directos y de operación, el plan de implantación, supervisión, los procedimientos de seguridad, el escalado y el mantenimiento, así como gestionar y asegurar la calidad en el proceso de desarrollo
- CE9** Capacidad para resolver la convergencia, interoperabilidad y diseño de redes heterogéneas con redes locales, de acceso y troncales, así como la integración de servicios de telefonía, datos, televisión e interactivos
- CG4** Que los estudiantes sepan comunicar sus conclusiones ¿y los conocimientos y razones últimas que las sustentan¿ a públicos especializados y no especializados de un modo claro y sin ambigüedades
- CT5** Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de documentos técnicos y científicos, de una manera adecuada y eficiente
- CG5** Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo
- CT6** Capacidad para emitir juicios sobre implicaciones económicas, administrativas, sociales, éticas y medioambientales ligadas a la aplicación de sus conocimientos
- CT4** Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo
- CE6** Capacidad para modelar, diseñar, implantar, gestionar, operar, administrar y mantener redes, servicios y contenidos
- CT3** Capacidad para adoptar soluciones creativas que satisfagan adecuadamente las diferentes necesidades planteadas
- CT1** Capacidad para comprender los contenidos de documentación en lengua inglesa

### Skills

- HE8** Capacidad de comprender y saber aplicar el funcionamiento y organización de Internet, las tecnologías y protocolos de Internet de nueva generación, los modelos de componentes, software intermediario y servicios

## DESCRIPTION

**Networks, Applications and Content (REAC)** provides an integrated view of the technologies, architectures, and services that support digital applications and content on the Internet. Building upon the fundamental principles of Internet operation and its most relevant protocols, the course examines the technologies and architectures that underpin Internet-based applications and services, including web application architectures, cloud services, and content delivery networks.

The course addresses the main challenges associated with the design and operation of Internet applications and services, including performance, scalability, security, and Quality of Experience (QoE). It combines theoretical foundations with practical activities focused on the analysis, design, and evaluation of the underlying technologies and architectures.

As an application of the concepts covered, different types of Internet applications and services are examined, including social networks, e-commerce platforms, streaming services, and other advanced digital services, identifying the technologies and architectures that enable their operation and evolution.

## TOPICS

### 1. Introduction to Networks, Applications and Content

- 1.1. Evolution of Internet applications. Types of applications and their requirements.
- 1.2. Operator-provided services versus Over-The-Top (OTT) services.
- 1.3. The role of cloud service providers.

### 2. Scalable Web Applications

- 2.1. Web application architecture. Layers.
- 2.2. Scalability and load balancing.
- 2.3. Virtualization, microservices, and containers.

### 3. Cloud Provider Architectures and Services

- 3.1. Network architecture. Regions and availability zones.
- 3.2. Services: virtual servers, storage, and other cloud services
- 3.3. Case studies (Amazon Web Services, Google Cloud).

### 3.4. Content Delivery Networks (CDNs).

## 4. Case Studies

### 4.1. E-commerce applications.

### 4.2. Streaming services.

### 4.3. Social networks.

### 4.4. Other case studies.

## ACTIVITIES



Assessment activity



Learning activity

|                                                                                                                                                                     |                |                       |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| <div></div> <div>Topic 1. Introduction to Networks, Applications and Content</div> |                |                       | <div>WEEKS</div> <div><div>1</div><div>2</div><div>3</div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>10</div><div>11</div><div>12</div><div>13</div><div>14</div><div>15</div><div>E</div></div> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FORMAT                                                                                                                                                              | TOTAL DURATION | LOCATION              | GROUP                                                                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| In-person                                                                                                                                                           | 01h 10m        | Classroom (scheduled) | Normal                                                                                                                                                                                                                             |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| TOPICS                                                                                                                                                              |                |                       |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div>T1</div>                                                                                                                                                       |                |                       |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| METHODOLOGY                                                                                                                                                         |                |                       |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div>Lecture</div>                                                                                                                                                  |                |                       |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| <div></div> <div>Topic 2. Scalable Web Applications</div> |                |                       | <div>WEEKS</div> <div><div>1</div><div>2</div><div>3</div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>10</div><div>11</div><div>12</div><div>13</div><div>14</div><div>15</div><div>E</div></div> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FORMAT                                                                                                                                       | TOTAL DURATION | LOCATION              | GROUP                                                                                                                                                                                                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| In-person                                                                                                                                    | 05h 50m        | Classroom (scheduled) | Normal                                                                                                                                                                                                                             |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| TOPICS                                                                                                                                       |                |                       |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div>T2</div>                                                                                                                                |                |                       |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| METHODOLOGY                                                                                                                                  |                |                       |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div>Lecture</div>                                                                                                                           |                |                       |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Laboratory 1. Scalable Web Application Deployment

WEEKS

1

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15

E

FORMAT

In-person

TOTAL DURATION

07h 00m

LOCATION

Laboratory

GROUP

Reduced

TOPICS

T2

METHODOLOGY

Laboratory assignments

Laboratory 1 . Assignment Submission

WEEKS

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

E

FORMAT

Not in person, without teacher

TOTAL DURATION

02h 00m

ASSESSMENT

Progressive

WEIGHT

10%

MINIMUM GRADE

4

TOPICS

T2

METHODOLOGY

Work in group

ASSESSED OUTCOMES

CE6

CE7

CG4

CT4

CT3

HE8

Topic 3. Cloud Infrastructures and Services

WEEKS

1

2

3

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11

12

13

14

15

E

FORMAT

In-person

TOTAL DURATION

07h 00m

LOCATION

Classroom (scheduled)

GROUP

Normal

TOPICS

T3

METHODOLOGY

Lecture

|                                                                   |                           |                            |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |               |                    |  |  |  |  |
|-------------------------------------------------------------------|---------------------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|---------------|--------------------|--|--|--|--|
| <div><div><div></div><div></div></div></div> <div>Partial 1</div> |                           |                            | <div>WEEKS</div> <div><div>1</div><div>2</div><div>3</div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>10</div><div>11</div><div>12</div><div>13</div><div>14</div><div>15</div><div>E</div></div> |  |  |  |  |  |  |  |  |  |               |                    |  |  |  |  |
| FORMAT<br>In-person                                               | TOTAL DURATION<br>02h 00m | LOCATION<br>Exam Classroom | ASSESSMENT<br>Progressive, Global, Retake (Extraordinary)                                                                                                                                                                          |  |  |  |  |  |  |  |  |  | WEIGHT<br>30% | MINIMUM GRADE<br>4 |  |  |  |  |
| TOPICS                                                            |                           |                            |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |               |                    |  |  |  |  |
| <div>T1</div> <div>T2</div>                                       |                           |                            |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |               |                    |  |  |  |  |
| METHODOLOGY                                                       |                           |                            |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |               |                    |  |  |  |  |
| <div>Written exam</div>                                           |                           |                            |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |               |                    |  |  |  |  |
| ASSESSED OUTCOMES                                                 |                           |                            |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |               |                    |  |  |  |  |
| <div>CE6</div> <div>CE7</div> <div>HE8</div> <div>CE9</div>       |                           |                            |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |               |                    |  |  |  |  |

|                                                                                                               |                           |                        |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| <div><div><div></div><div></div></div></div> <div>Laboratory 2. Deployment of an E-commerce Application</div> |                           |                        | <div>WEEKS</div> <div><div>1</div><div>2</div><div>3</div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>10</div><div>11</div><div>12</div><div>13</div><div>14</div><div>15</div><div>E</div></div> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FORMAT<br>In-person                                                                                           | TOTAL DURATION<br>07h 00m | LOCATION<br>Laboratory | GROUP<br>Reduced                                                                                                                                                                                                                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| METHODOLOGY                                                                                                   |                           |                        |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div>Laboratory assignments</div>                                                                             |                           |                        |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|                                                                                              |                           |                           |                                                                                                                                                                                                                                    |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| <div><div><div></div><div></div></div></div> <div>Laboratory 2 . Assignment Submission</div> |                           |                           | <div>WEEKS</div> <div><div>1</div><div>2</div><div>3</div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>10</div><div>11</div><div>12</div><div>13</div><div>14</div><div>15</div><div>E</div></div> |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FORMAT<br>Not in person, without teacher                                                     | TOTAL DURATION<br>02h 00m | ASSESSMENT<br>Progressive | WEIGHT<br>10%                                                                                                                                                                                                                      | MINIMUM GRADE<br>4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| TOPICS                                                                                       |                           |                           |                                                                                                                                                                                                                                    |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div>T3</div>                                                                                |                           |                           |                                                                                                                                                                                                                                    |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| METHODOLOGY                                                                                  |                           |                           |                                                                                                                                                                                                                                    |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div>Work in group</div>                                                                     |                           |                           |                                                                                                                                                                                                                                    |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ASSESSED OUTCOMES                                                                            |                           |                           |                                                                                                                                                                                                                                    |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div>CT4</div> <div>CT3</div> <div>CE6</div> <div>CE7</div> <div>CG4</div>                   |                           |                           |                                                                                                                                                                                                                                    |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| <div><div><div></div><div></div></div></div> <div>Topic 4. Case Studies</div> |                           |                                   | <div>WEEKS</div> <div><div>1</div><div>2</div><div>3</div><div>4</div><div>5</div><div>6</div><div>7</div><div>8</div><div>9</div><div>10</div><div>11</div><div>12</div><div>13</div><div>14</div><div>15</div><div>E</div></div> |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FORMAT<br>In-person                                                           | TOTAL DURATION<br>07h 00m | LOCATION<br>Classroom (scheduled) | GROUP<br>Normal                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| TOPICS                                                                        |                           |                                   |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div>T4</div>                                                                 |                           |                                   |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| METHODOLOGY                                                                   |                           |                                   |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <div>Lecture</div>                                                            |                           |                                   |                                                                                                                                                                                                                                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|                                                                                                                                              |                           |                        |                  |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  <b>Laboratory 3. Deployment of a Streaming Application</b> |                           |                        |                  | WEEKS<br>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FORMAT<br>In-person                                                                                                                          | TOTAL DURATION<br>11h 00m | LOCATION<br>Laboratory | GROUP<br>Reduced |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| TOPICS<br>T4                                                                                                                                 |                           |                        |                  |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| METHODOLOGY<br>Laboratory assignments                                                                                                        |                           |                        |                  |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|                                                                                                                               |                           |                           |               |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------------------------------------------------------------------------------------------------------------------|---------------------------|---------------------------|---------------|------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
|  <b>Laboratory 3 . Assignment Submission</b> |                           |                           |               | WEEKS<br>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FORMAT<br>Not in person, without teacher                                                                                      | TOTAL DURATION<br>04h 00m | ASSESSMENT<br>Progressive | WEIGHT<br>20% | MINIMUM GRADE<br>4                             |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| TOPICS<br>T3 T4                                                                                                               |                           |                           |               |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| METHODOLOGY<br>Work in group                                                                                                  |                           |                           |               |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ASSESSED OUTCOMES<br>CE6 CE9 CG4 CT4 CT5                                                                                      |                           |                           |               |                                                |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|                                                                                                      |                           |                            |                                                           |                                                |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  <b>Partial 2</b> |                           |                            |                                                           | WEEKS<br>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 E |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FORMAT<br>In-person                                                                                  | TOTAL DURATION<br>02h 00m | LOCATION<br>Exam Classroom | ASSESSMENT<br>Progressive, Global, Retake (Extraordinary) | WEIGHT<br>30%                                  | MINIMUM GRADE<br>4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| TOPICS<br>T4 T3                                                                                      |                           |                            |                                                           |                                                |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| METHODOLOGY<br>Written exam                                                                          |                           |                            |                                                           |                                                |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ASSESSED OUTCOMES<br>CT6 CT5 CT3 CT1 CG5 CG4 CE9 HE8 CE7 CE6                                         |                           |                            |                                                           |                                                |                    |  |  |  |  |  |  |  |  |  |  |  |  |  |  |



Laboratory Practices Examination

WEEKS

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E

|           |                |                |                                |        |               |
|-----------|----------------|----------------|--------------------------------|--------|---------------|
| FORMAT    | TOTAL DURATION | LOCATION       | ASSESSMENT                     | WEIGHT | MINIMUM GRADE |
| In-person | 01h 00m        | Exam Classroom | Global, Retake (Extraordinary) | 40%    | 4             |

TOPICS

T2 T3 T4

METHODOLOGY

Problem-solving exam

ASSESSED OUTCOMES

CE6 CE7 HE8 CE9 CG4 CG5 CT1 CT4 CT5

## WEEKLY SCHEDULE

 Assessment activity
  Learning activity
  Week with activity
  Exam period

| Activity                                                                                                                                       | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | E |
|------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|---|
|  Topic 1. Introduction to Networks, Applications and Content | . |   |   |   |   |   |   |   |   |    |    |    |    |    |    |   |
|  Topic 2. Scalable Web Applications                         | . | . |   |   |   |   |   |   |   |    |    |    |    |    |    |   |
|  Laboratory 1. Scalable Web Application Deployment          |   |   | . | . |   |   |   |   |   |    |    |    |    |    |    |   |
|  Laboratory 1 . Assignment Submission                       |   |   |   | . |   |   |   |   |   |    |    |    |    |    |    |   |
|  Topic 3. Cloud Infrastructures and Services                |   |   |   |   | . | . |   |   |   |    |    |    |    |    |    |   |
|  Partial 1                                                  |   |   |   |   |   |   | . |   |   |    |    |    |    |    |    |   |
|  Laboratory 2. Deployment of an E-commerce Application      |   |   |   |   |   |   | . | . |   |    |    |    |    |    |    |   |
|  Laboratory 2 . Assignment Submission                       |   |   |   |   |   |   |   | . |   |    |    |    |    |    |    |   |
|  Topic 4. Case Studies                                      |   |   |   |   |   |   |   |   | . | .  |    |    |    |    |    |   |
|  Laboratory 3. Deployment of a Streaming Application        |   |   |   |   |   |   |   |   |   |    | .  | .  | .  |    |    |   |



| Activity                                                                                                               | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | E |
|------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|---|
|  Laboratory 3 . Assignment Submission |   |   |   |   |   |   |   |   |   |    |    |    | •  |    |    |   |
|  Partial 2                            |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    | • |
|  Laboratory Practices Examination     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    | • |

## ASSESSMENT CRITERIA

### General criteria

The course will be passed when a final grade equal to or greater than 5.0 out of 10 is obtained.

The final grade will be calculated as the weighted sum of the marks obtained in the different assessment activities, according to the following weights:

- Partial Exam 1: 30%
- Partial Exam 2: 30%
- Laboratory Assignments (or Laboratory Examination): 40%

To calculate the final grade and, therefore, to pass the course, it is mandatory to achieve at least the minimum grade established for each assessment activity.

The examinations will consist of theoretical and practical questions and problem-solving exercises, and may also include multiple-choice questions. Solutions to multiple-choice questions will not be published when such questions are drawn from a question bank.

### Assessment criteria for the regular exam period. Progressive assessment

#### Assessment criteria

To pass the progressive assessment process, it is mandatory to achieve at least the minimum grade required for each assessment activity.

If the grade obtained in **Partial Exam 1** is below the required minimum, the student must retake this examination on the date scheduled for the **ordinary global assessment examination**. In this case, the grade obtained in the retake examination will replace the original grade for **Partial Exam 1**.

If the grade obtained in the **Laboratory Assignments** is below the required minimum, the student must take a **Laboratory Examination** on the date scheduled for the ordinary global assessment examination. In this case, the

grade obtained in the Laboratory Examination will replace the original grade for the laboratory assignments.

#### Activities

- Laboratory 1 . Assignment Submission (10%)
- Partial 1 (30%)
- Laboratory 2 . Assignment Submission (10%)
- Laboratory 3 . Assignment Submission (20%)
- Partial 2 (30%)

### Assessment criteria for the regular exam period. Global assessment

#### Assessment criteria

The course will be passed when a final grade equal to or greater than 5.0 out of 10 is obtained.

If the course is not passed, grades of 5.0 or higher obtained in any assessment activity will be carried forward to the extraordinary examination period.

#### Activities

- Partial 1 (30%)
- Partial 2 (30%)
- Laboratory Practices Examination (40%)

### Assessment criteria for the retake (extraordinary) exam period

#### Assessment criteria

The course will be passed when a final grade equal to or greater than **5.0 out of 10** is obtained.

Students will only be required to retake those assessment activities for which a grade below 5.0 was obtained in the ordinary examination period.

#### Activities

- Partial 1 (30%)
- Partial 2 (30%)
- Laboratory Practices Examination (40%)

## RESOURCES

### Bibliography

- J. F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach, 9th ed., Pearson, 2025.
- M. Kleppmann, Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, O'Reilly Media, 2017.
- S. Newman, Building Microservices: Designing Fine-Grained Systems, 2nd ed., O'Reilly Media, 2021.
- F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach, 9th ed., Pearson, 2025.
- T. Erl, R. Puttini and Z. Mahmood, Cloud Computing: Concepts, Technology & Architecture, Pearson Education, 2013.
- A. Ejsmont, Web Scalability for Startup Engineers, McGraw-Hill Education, 2015.

*Core References*

## Web

- Netflix Technology Blog
- Amazon Web Services (AWS), AWS Documentation.
- Google Cloud, Google Cloud Documentation.

*Online Resources and Technical Documentation*

## SUSTAINABLE DEVELOPMENT GOALS



**Quality Education**



**Industry, Innovation and Infrastructure**