Course guide
240309 - 240IIT21 - Data Process and Communication

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 723 - CS - Department of Computer Science.
Degree: MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
Academic year: 2023  ECTS Credits: 4.5  Languages: Catalan

LECTURER
Coordinating lecturer: Josep Vilaplana Pastó

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEETI5. (ENG) Dissenyar sistemes de comunicació que enllacen sensors, controladors i actuadors (Competència específica associada a l'especialitat en Tecnologies de la Informació per a la Industria).
CEETI2. (ENG) Modelar sistemes de comunicació i gestió de dades entre processos mitjançant protocols de comunicació i de forma segura. (Competència específica associada a l'especialitat en Tecnologies de la Informació per a la Industria).

TEACHING METHODOLOGY
The subject will be taught in theory sessions alternating the theoretical and practical part. The practical part will consist of solving exercises and doing practical work. The learning of this subject will depend a lot on the personal work of the students.

LEARNING OBJECTIVES OF THE SUBJECT
Introduce students to the basics to follow the new trends in industry digitalization, and facilitate further study in other subjects. Gain basic knowledge of computer structure, organization, and networking. Basic knowledge of communication protocols. Introduce the student to the development of concurrent applications, exchange of messages and protocols, within the field of the Internet of Things (IoT) and web servers. Gain basic knowledge of data security, management and learning techniques.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>40,5</td>
<td>36.00</td>
</tr>
<tr>
<td>Self study</td>
<td>72,0</td>
<td>64.00</td>
</tr>
</tbody>
</table>

Total learning time: 112.5 h
## CONTENTS

<table>
<thead>
<tr>
<th>Structure and operation of computers and multiprocessor systems.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> The operation of the Von Neuman type computer is explained by describing the interaction and operation of the processor components (arithmetic-logic unit, registers, etc.), memory, bus, and input / output. The advantages and disadvantages of the different interconnection systems between many processors and memories are then studied.</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong> The student will be able to describe the structure and operation of the main components of a computer. The student will be able to understand the performance of a computer according to the interconnection between its components. The student will be able to evaluate network configurations between processors and memories.</td>
</tr>
<tr>
<td><strong>Full-or-part-time:</strong> 4h</td>
</tr>
<tr>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Self study : 2h</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> The operation of an operating system is explained with special emphasis on processor scheduling and virtual memory management. Among the various types of operating systems, real-time operating systems are explained with more detail.</td>
</tr>
<tr>
<td><strong>Specific objectives:</strong> Know the main functions of an operating system and the reason for its need. Understand the role that the operating system plays in the efficient management of the processor, memory, and peripherals. Know how to program with libraries of the operating system.</td>
</tr>
<tr>
<td><strong>Full-or-part-time:</strong> 10h</td>
</tr>
<tr>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td>Self study : 6h</td>
</tr>
</tbody>
</table>
**Computer networks**

**Description:**

**Specific objectives:**
Know the basics of the internet, the packet network, standards.

Know the format of an IP datagram. IP addressing. Datagram routing.

Know the TCP protocol. Communication of applications by sockets.

Have basic notions of network security and protection.

Know other specific protocols and their advantages and disadvantages. CAN for automotive, LPWAN, zigbee, NFC, bluetooth (MQTT, XMPP, ...) for IoT.

**Full-or-part-time:** 30h
Theory classes: 6h
Practical classes: 6h
Self study: 18h

---

**Concurrent Programming**

**Description:**
Concurrent programming is introduced and possible conflicts (mutual exclusion, indefinite blocking, starvation, etc.) that may be found are studied. Two ways of approaching concurrent programming are studied: Programming by means of execution threads, programming by means of separate processes.

**Specific objectives:**
Be able to develop concurrent programs that share memory.

Understand interference and blockages in a concurrent system.

Know how to apply techniques that avoid interference and blockages in concurrent programs.

Be able to develop concurrent programs that pass messages

**Full-or-part-time:** 24h
Theory classes: 3h
Practical classes: 6h
Self study: 15h
Distributed systems.

**Description:**
The principles on which distributed systems are based are described. Models are introduced to build distributed applications that facilitate the correctness, reliability, and scalability of the application. Some real examples will be studied.

**Specific objectives:**
Understand that it means a distributed system and what are the problems to be faced for its design and implementation (concurrence, lack of a single control, heterogeneity, fault tolerance, scalability, ...).

Know possible applications of a distributed system.

Apply a distributed system paradigm (client-server, processor farm, etc.) in the context of IIOT.

**Full-or-part-time:** 23h
Theory classes: 2h
Practical classes: 6h
Self study: 15h

---

Machine learning

**Description:**
Neural networks are introduced and their application in the field of machine learning

**Specific objectives:**
Introduce the fundamentals of machine learning.

Know the various techniques for solving machine learning problems.

**Full-or-part-time:** 20h
Theory classes: 2h
Practical classes: 6h
Self study: 12h

---

**GRADING SYSTEM**

Throughout the course there will be three assignements L1, L2 and L3. The final grade of the subject will be calculated as

\[ NF = \max (0.6 \times NL + 0.4 \times NEF, NEF) \]

and

\[ NAC = 0.2 \times L1 + 0.3 \times L2 + 0.5 \times L3 \]

\[ NEF = \text{final exam grade.} \]
BIBLIOGRAPHY

Complementary:

RESOURCES

Hyperlink: