270064 - XC2 - Computer Networks II

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 701 - AC - Department of Computer Architecture
Academic year: 2019
Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Spanish

Teaching staff
Coordinator: Davide Careglio (careglio@ac.upc.edu)
Others: German Santos Boada (german@ac.upc.edu)

Prior skills

Students should've learned the basics of communication between terminals connected to a network. This requires having studied the stack TCP / IP protocols and architecture of Local Area Networks (LAN) and wide area network (WAN). In particular protocols and algorithms related to network architecture and protocol stack TCP / IP as the technological aspects of networks (planning and design of a Local Area Network).

Requirements

- Prerequisite XC

Degree competences to which the subject contributes

Specific:
CEC2.2. To program taking into account the hardware architecture, using assembly language as well as high-level programming languages.
CEC2.3. To develop and analyse software for systems based on microprocessors and its interfaces with users and other devices.
CEC2.4. To design and implement system and communications software.
CEC4.1. To design, deploy, administrate and manage computer networks.
CT6.1. To demonstrate knowledge and capacity to manage and maintain computer systems, services and applications.
CT6.4. To demonstrate knowledge and capacity to apply the characteristics, functionalities and structure of the Distributed Systems and Computer and Internet Networks guaranteeing its use and management, as well as the design and implementation of application based on them.
CT7.3. To determine the factors that affect negatively the security and reliability of a hardware/software system, and minimize its effects.

Generic:
G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.
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Teaching methodology

1. Activities focused on acquiring theoretical knowledge.
2. Activities (meetings) focused on acquiring the laboratory for testing.
3. The theory classes would be divided into classes of exposure, readings of articles or group work.

Theory:
- Theoretical sessions (2 hours / week)
- Completed application session with the concepts through problem solving (1 hour / week).

Laboratory
- Classes 2 hours every 2 weeks when they learn to set some important protocols. The goal is to complete the practical aspects seen in theory.
- Preparation: reading statement and additional documentation
- Working in the lab in group
- Work at home to finish (report)

Workgroup activities:
- Classroom (teacher and students)
- No person (each student on their own).

Learning objectives of the subject

1. Students must understand the technological aspects that impact on economic, social and environmental phenomena.
2. The student must know how the whole Internet and how they communicate the applications installed in the terminals.
3. Students will be able to manage and maintain systems, services and applications.
4. Students will be able to design, deploy, maintain and manage computer networks
5. The student will become familiar with the technology, protocols, terminology and specific recommendations of major international character of the area of systems based on microprocessors
6. Students must know how to differentiate and understand the various aspects to ensure safety and reliability of a system.
7. Students will become familiar with the technology, protocols, terminology and specific recommendations of major international the Internet.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 30h</th>
<th>20.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>15h</td>
<td>10.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>6h</td>
<td>4.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>84h</td>
<td>56.00%</td>
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</tbody>
</table>
## Content

### Presentation of the course and review of previous concepts

**Degree competences to which the content contributes:**

**Description:**
Review the basics of communications between terminals connected to a network stack and TCP / IP protocols and architecture of Local Area Networks (LAN) and wide area network (WAN).

### Architecture and addressing in Internet

**Degree competences to which the content contributes:**

**Description:**
Introduction to various topics of this first part of the syllabus. It examines the hierarchy of the Internet and the definitions of autonomous systems (AS) and Internet Service Provider (ISP). The main actors and organizations of Internet are identified.

### Exhaustion IPv4 and introduction of IPv6

**Degree competences to which the content contributes:**

**Description:**
We analyze the problem of IPv4 address exhaustion. IPv6 is introduced as a replacement for IPv4 and its operation explained.

### Intra-domain routing

**Degree competences to which the content contributes:**

**Description:**
The OSPF routing protocol for dynamic networks intradomain will be introduced and examples of operation will be given both during theoretical classes and in the laboratory.

### Inter-domain routing

**Degree competences to which the content contributes:**

**Description:**
The BGP routing protocol for dynamic networks interdomain will be presented. Examples of behaviour during both theoretical classes and in laboratory will be seen. The concepts of stub, multihoming, and transit AS will be defined and studied.

### Advanced concepts in networking

**Degree competences to which the content contributes:**
## Description:
MPLS is introduced as an improvement to control flows on a network as well as its label management protocol called LDP. We explain the integration of concepts of traffic engineering (TE) on networks and we introduce the OSPF-TE, RSVP-TE and MPLS-TE protocols. Finally multicast protocols are analyzed for the intra-domain and inter-domain cases.

## Current research activities

### Degree competences to which the content contributes:

### Description:
Some research topics related to future Internet networks will be presented and group complementary activities proposed.
## Planning of activities

<table>
<thead>
<tr>
<th>Planning of activities</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Presentation of the course and review of previous concepts</strong></td>
<td>8h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>The student has to know the basics of communications between terminals connected to a</td>
<td></td>
</tr>
<tr>
<td>network stack and TCP/IP protocols and architecture of Local Area Networks (LAN) and</td>
<td></td>
</tr>
<tr>
<td>wide area network (WAN).</td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Introduction to administration and maintenance of ISPs</strong></td>
<td>9h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>Students will become familiar with specific terminology and recommendations of major</td>
<td></td>
</tr>
<tr>
<td>international fora regarding Internet. Students must understand the hierarchy of the</td>
<td></td>
</tr>
<tr>
<td>Internet and how communication work between the different levels.</td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>2, 7</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Autonomous systems management</strong></td>
<td>12h</td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
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<tr>
<td>Students must understand the hierarchy of Internet and the concepts of autonomous</td>
<td></td>
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<tr>
<td>systems. Students will be able to distinguish between stub autonomous system,</td>
<td></td>
</tr>
<tr>
<td>multihoming with transit capability or not.</td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>1, 2, 3, 7</td>
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</table>
### Intra-domain dynamic routing: the OSPF protocol

**Hours:** 16h  
- Theory classes: 4h  
- Practical classes: 2h  
- Laboratory classes: 2h  
- Guided activities: 0h  
- Self study: 8h

**Description:**  
Students will become familiar with the OSPF protocol through theoretical examples in class, practical problems and configuration problems through exercises and in the laboratory.

**Specific objectives:**  
1, 2, 3, 4, 6, 7

### Interdomain routing: the BGP protocol

**Hours:** 38h  
- Theory classes: 10h  
- Practical classes: 6h  
- Laboratory classes: 8h  
- Guided activities: 0h  
- Self study: 14h

**Description:**  
Students will become familiar with the BGP protocol through theoretical examples in class, practical problems and configuration problems in the laboratory.

**Specific objectives:**  
1, 2, 3, 6, 7

### Midterm control evaluation

**Hours:** 7h  
- Guided activities: 1h  
- Self study: 6h

**Description:**  
Midterm control evaluation on the subjects exposed to the theory classes.

**Specific objectives:**  
1, 2, 3, 7

### Presentation of research topics

**Hours:** 2h  
- Theory classes: 2h  
- Practical classes: 0h  
- Laboratory classes: 0h  
- Guided activities: 0h  
- Self study: 0h

**Description:**  
Students will become familiar with the research and recommendations of major international networks in the field.
### Specific objectives:
1, 5

### Advanced concepts in networking

<table>
<thead>
<tr>
<th>Hours</th>
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<tbody>
<tr>
<td>Theory classes: 4h</td>
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<tr>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 8h</td>
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</tbody>
</table>

**Description:**
The student will become familiar with advanced networking concepts currently in use. The student will know, compare and distinguish the different solutions.

**Specific objectives:**
1, 3, 4, 6

### Development of a report on a topic related to research in Internet.

<table>
<thead>
<tr>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td>Laboratory classes: 0h</td>
</tr>
<tr>
<td>Guided activities: 4h</td>
</tr>
<tr>
<td>Self study: 14h</td>
</tr>
</tbody>
</table>

**Description:**
Each group must select a topic and present after 3 weeks a report describing the problem, analyzing the available solutions and, where appropriate, proposing new solutions.

**Specific objectives:**
1, 5, 6

### Lab Final Exam

<table>
<thead>
<tr>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 0h</td>
</tr>
<tr>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td>Laboratory classes: 1h</td>
</tr>
<tr>
<td>Guided activities: 0h</td>
</tr>
<tr>
<td>Self study: 0h</td>
</tr>
</tbody>
</table>

**Description:**
Prepare the lab exam study notes and previous practices.

**Specific objectives:**
3, 4, 5
Final control evaluation

| Description: | Final control evaluation on the subjects exposed to the theory classes. |
| Specific objectives: | 1, 4, 5, 6 |

Hours: 7h
- Guided activities: 1h
- Self study: 6h

Final exam

| Description: | Final exam on the subjects exposed to the theory classes |
| Specific objectives: | 1, 2, 3, 4, 5, 6, 7 |

Hours: 14h
- Guided activities: 2h
- Self study: 12h

Qualification system

1. A mid-term exam (25%), an end-of-term exam (25%) and a final exam (50%) on the subject exposed to the theory classes. Theory = 0.25 x mid-term + 0.25 x end-of-term + 0.5 x Final Exam

2. Lab sessions: Evaluated by short control at the end of each session and a final exam. The lab mark consists of the average of the lab sessions mark (50%) and the final exam (50%).

3. Group Assignments. In groups of 2-3 people, the lab and theory professors will suggest some complementary activities which will end-up in a report. The Group Assignments mark will be the average of all assignments made by the professors.

The final grade of the course will be calculated as follows:
$$N = 0.6 \times \text{Theory} + 0.25 \times \text{Lab} + 0.15 \times \text{GroupAssignments}$$

The achievement of the generic competence will be assessed from the notes of the exams, the labs and the assignments. The mark of the competence will be computed as follows:
- A if $8.5 \leq N$
- B if $7 \leq N < 8.5$
- C if $5 \leq N < 7$
- D if $N < 5$
Bibliography

Basic:


Complementary:


Others resources:

Hyperlink

http://www.ietf.org

http://ipj.dreamhosters.com

Internet Protocol Journal