COURSE PROGRAM

Academic Year: 2024/25

Identification and characteristics of the course				
Code	501319	ECTS Credits		6
Course name (English)	Network Architecture and Protocols			
Course name (Spanish)	Arquitectura de Redes y Protocolos			
Degree programs	Bachelor Degree in Computer Science - Software Engineering			
Faculty/School	School of Technology			
Semester	6th	Type of course	Mandatory	
Module	Specific Technology in Software Engineering			
Matter	Network Architecture			
Lecturer/s				
Name		Office	E-mail	Web page
Jaime Galán Jiménez (Theory and laboratory)		70	jaime@unex.es	
Mar Ávila Vegas (Laboratory)		42	mmavila@unex.es	
Subject Area	Telematics Engineering			
Department	Department of Computer Systems and Telematics Engineering			

Competencies
Basic Competencies (CB)
CB 1. That the students should have demonstrated that they have knowledge and understanding of concepts in the field of study that build on the basis of general secondary education and are at a level which, while supported by advanced texts, also include certain aspects that imply understanding of cutting-edge knowledge in the field of study.
CB 2. That the students should know how to apply their knowledge in a professional way to their work or vocation and have the competences that are usually demonstrated by means of the preparation and defence of arguments and problem solving within their area of study.
CB 3. That the students should have the capacity to collect and interpret relevant data (within their area of study) so as to form judgements that include a reflection upon social, scientific and ethical issues.
CB 4. That the students are able to transmit information, ideas, problems and solutions to both specialized and non-specialized audiences.
CB 5. That the students should have developed those learning abilities necessary for future independent study.
Specific Competencies on Software Engineering (CIS)
CIS03. Ability to solve integration problems as a function of available strategies, standards and technologies.
CIS06. Ability to design appropriate solutions in one or more application domains by using software engineering methods that join ethical, social, legal and economical aspects.
Transverse Competencies (CT)
CT04. Effective writing communication ability.
CT09. Teamwork ability.

Contents

Course outline

To know architectures, operation and basics of telematics systems. To know the TCP/IP protocol stack, especially the upper layers (transport and application).

Course syllabus

Theory

Lesson 1: Introduction

1. What is the Internet?
2. Network edge.
3. Network core.
4. Delay, loss, throughput in networks.
5. ISO and TCP/IP architectures. Comparison. Levels and sub-levels.
6. Protocol layers and service models.

Lesson 2: Network layer. The data plane

1. Introduction to the network layer of the TCP/IP architecture.
2. What's inside a router.
3. IPv4 protocol.
4. IPv6 protocol.
5. Generalized forwarding and SDN.

Lesson 3: Network layer. The control plane

1. Introduction.
2. Routing algorithms: Link State (LS) and Distance Vector (DV).
3. Intra-domain routing: OSPF.
4. Inter-domain routing: BGP.
5. The SDN control plane.
6. ICMP Protocol.
7. SNMP Protocol.

Lesson 4: Transport layer

1. Features of the Transport layer.
2. TCP protocol.
3. UDP protocol.
4. Real-time transport protocols: RTP and RTCP.

Lesson 5: Application layer

1. Introduction. Principles of network applications.
2. The Web and the HTTP protocol.
3. Electronic mail. SMTP protocol.
4. DNS protocol.
5. P2P file sharing.

Laboratory

Lecture 1: Introduction to Packet Tracer, Servers and Subnetting
Contents of Lecture 1:

- Packet Tracer workspaces.
- Device creation/connection, module addition, layout creation, etc.
- Environments creation: basic network, connection between networks, etc.

Lecture 2: Introduction to routing in Packet Tracer I.
Contents of Lecture 2:

- Routing protocols. Types.
- Static routing.
- Dynamic routing.

Lecture 3: Routing in Packet Tracer II and other concepts.
Contents of Lecture 3:

- Switching and routing.
- Subnetting.
- Routing between VLAN.

- Default routes. Cisco commands.

Lecture 4: Network traffic monitoring: The Internet (IP) Layer
Contents of Lecture 4:

- Traffic analysis with Wireshark.
- Identification of the IP header.
- ICMP traffic analysis: Ping, traceroute.
- IP fragmentation.

Lecture 5: Network traffic monitoring: The Transport (TCP and UDP) Layer
Contents of Lecture 5:

- Identification of TCP/UDP headers.
- TCP traffic analysis: connection establishment, data transfer and connection release.
- Flow control and congestion control in TCP.
- UDP traffic analysis.

Lecture 6: Network traffic monitoring: The Application Layer
Contents of Lecture 6:

- HTTP traffic analysis.
- DNS traffic analysis.
- 5 global hours of this practical activity will be used to introduce English expressions on terminology about communication networks and protocols.

Educational activities

Student workload in hours by lesson		Lectures	Practical activities	Monitoring activity	Homework
Lesson	**Total**	**L**	**LAB**	**SGT**	**PS**
1	9	3	0	0	6
2	47	9	9	1	28
3	37,5	7	6,5	1	23
4	19	9	3	1	6
5	27,5	6,5	3	0	18
Assessment	10	3	1	0	6
TOTAL	150	37,5	22,5	3	87

L: Lectures (100 students)
LAB: Laboratory or field practices (15 students)
SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)
PS: Personal study, individual or group work and reading of bibliography

Teaching Methodologies

- Theory and practice lessons at classroom. Brief activities, individually or in a group, to allow the students apply the explained concepts and solve the proposed problems. Stimulation of student's participation.
- Practical lessons in the laboratory. Practical activities, lectures with guidelines, seminaries to solve problems, etc. in groups under the advice of a lecturer. In order to achieve the proposed objectives, additional activities can be added before or after practical lessons. Activities related to project development, hypothetical scenarios, technical reports, etc. will be proposed.
- Monitoring activities, both individually or in a small group. A follow-up for students monitoring will be done by means of training and orientation activities. These activities will be mainly used to monitor the proposed assignments, to discuss different alternatives and to evaluate the proposed objectives.
- Activities, assignments, study, both individually or in a group. Those activities carried out autonomously by the student will be oriented to acquire basic knowledge within the scope of computer science, and on projects and assignments development.

Learning outcomes

Learning outcomes:

- To know general concepts related to computer networks such as communication protocols, network topologies, addressing, routing, segmentation, switching, etc.
- To know how to compare network architectures.
- To know the most commonly used communication protocols, especially the ones related to TCP/IP model.

Learning objectives of the course:

In order to acquire the aforementioned competencies and achieve the learning outcomes proposed, next learning objectives are set:

- Obj. 1: To know the set of methodologies and techniques on network administration, deployment and management.
- Obj. 2: To know the architecture that supports Internet operation and, especially, both transport and application layers.
- Obj. 3: To know the limitations of classical Internet protocols and the proposed solutions for network evolution.
- Obj. 4: To know and deeply analyse both flow and congestion control, belonging to the transport layer of a TCP/IP network.
- Obj. 5: To know the main application services a network is able to provide.
- Obj. 6: To know different network devices, similar to the ones that can be found in a production environment.
- Obj. 7: To administer and manage commercial network devices.
- Obj. 8: To deploy small network environments using commercial devices.
- Obj. 9: To create technical reports where different options are analysed and solutions for network deployment are proposed.

Evaluation tools:

The student will be able to choose if he/her wants to follow the continuous evaluation procedure or the global final one during the three first weeks of the semester.

Following the continuous evaluation, in order to evaluate the achievement of the proposed learning objectives, both the ones related to technical competencies and the ones that are referred to transversal competencies, different evaluation instruments are used:

- Activities related to the theoretical part.
- Written exams.
- Attendance to laboratory.
- Practical exams.

Theory:

Activities related to the theoretical part: Students will perform and deliver a set of continuous evaluation activities about the contents of the theoretical part. Apart from being an evaluation tool, these activities will let the students receive feedback from the lecturer as well as think about the achieved learning

Written exams: In order to guarantee the acquisition of minimal contents and skills related to technical competencies, 2 written exams will be carried out. Both exams will have the same weight and they will not have to be repeated during the course if one of them is passed. Each exam will be composed of problems, test questions, short questions, etc.

Laboratory:

Attendance to laboratory: It is an essential tool to achieve the proposed objectives, as well as to evaluate many of the technical and transversal competencies of a future Computer Science licensed. It is a very close activity to the ones a licensed will have to regularly face during his career: comprehension, management and maintenance of computer network systems.

Practical exams: In order to guarantee the acquisition of minimal contents and skills related to technical competencies, 2 practical exams will be carried out. Both exams will have the same weight and they will not have to be repeated during the course if one of them is passed. These exams will be carried out in the laboratory and will be composed of questions, problems and practical situations similar to the ones tackled during the lectures.

Students who do not follow the continuous evaluation option will have the opportunity to demonstrate the acquisition of subject competencies after doing two exams for theory and two exams for laboratory, which will allow the student to obtain the whole subject mark (100%).

Evaluation criteria

Subject final mark is obtained according next weights and considerations:

<table>
<tr><td colspan="2"></td><td colspan="2">Theory</td><td>Laboratory</td></tr>
<tr><td colspan="2">Relative weight</td><td colspan="2">60%</td><td>40%</td></tr>
<tr><td rowspan="2">Continuous evaluation</td><td>Evaluation blocks</td><td>Theoretical activities (20%)</td><td>2 written exams (40% each)</td><td>2 practical exams (50% each)</td></tr>
<tr><td>Min requirements</td><td colspan="2">Pass each exam with a mark of 5 at least.</td><td>Attendance to all laboratory lectures (max 1 absence).
Pass each practical exam with a mark of 5 at least.</td></tr>
<tr><td rowspan="2">Global evaluation</td><td>Evaluation blocks</td><td colspan="2">2 written exams</td><td>2 practical exams</td></tr>
<tr><td>Min requirements</td><td colspan="3">Pass each part (written exams and practical exams) with a minimum mark of 5.</td></tr>
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Additional remarks:

- The mark of the passed part (if minimum requirements are satisfied) will be saved to be used during the rest of calls in the course, if the student is allowed to use it.
- If both parts are failed, the final mark will be the lowest one.
- If one of the parts is failed, the final mark will be such mark, even though if the other part is passed or the student was absent.

Bibliography (basic and complementary)

- *Computer Networking: A Top-Down Approach (7th ed.).* J. F. Kurose and K. W. Ross. Pearson Education, 2017.
- *Computer Networks (4th ed.)*. A. S. Tanembaum. Pearson Education, 2004.
- *Network Administrator's Guide*. O. Kirch, T. Dawson. O'Reilly, 2000.
- *Linux Networking Cookbook*. C. Schroder. O'Really. 2007.
- *Routing TCP&IP, Volume 1 (2nd Edition)*. J. Doyle, J. Carroll. Cisco Press, 2005.

Other resources and complementary educational materials

Resources: subject's virtual room, available at the Campus Virtual of the University of Extremadura.