



POLITÉCNICA

INTERNATIONAL  
CAMPUS OF  
EXCELLENCE

COORDINATION PROCESS OF  
LEARNING ACTIVITIES  
PR/CL/001



E.T.S. de Ingenieros  
Industriales

# ANX-PR/CL/001-01

## LEARNING GUIDE

### SUBJECT

**53001552 - Communication Networks**

### DEGREE PROGRAMME

05BG - Master Universitario en Electronica Industrial

### ACADEMIC YEAR & SEMESTER

2020/21 - Semester 1

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## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	53001552 - Communication Networks
<b>No of credits</b>	3 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	First year
<b>Semester of tuition</b>	Semester 1
<b>Tuition period</b>	September-January
<b>Tuition languages</b>	English
<b>Degree programme</b>	05BG - Master Universitario en Electronica Industrial
<b>Centre</b>	05 - Escuela Tecnica Superior de Ingenieros Industriales
<b>Academic year</b>	2020-21

## 2. Faculty

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### 2.1. Faculty members with subject teaching role

<b>Name and surname</b>	<b>Office/Room</b>	<b>Email</b>	<b>Tutoring hours *</b>
Eduardo De La Torre Arnanz (Subject coordinator)		eduardo.delatorre@upm.es	--

\* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

## 3. Skills and learning outcomes \*

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### 3.1. Skills to be learned

CB06 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB07 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio

CB08 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CE02 - Ser capaz de desarrollar un proyecto de diseño de un sistema electrónico, identificando sus principales retos, en ámbitos de aplicación tales como el aeroespacial, la automoción, la ingeniería médica, las energías renovables o las comunicaciones

CG02 - Saber aplicar e integrar sus conocimientos, la comprensión de estos, su fundamentación científica y sus capacidades de resolución de problemas en entornos nuevos y definidos de forma imprecisa, incluyendo contextos de carácter multidisciplinar tanto investigadores como profesionales altamente especializados.

CG03 - Saber evaluar y seleccionar la teoría científica adecuada y la metodología precisa de sus campos de estudio para formular juicios a partir de información incompleta o limitada incluyendo, cuando sea preciso y pertinente, una reflexión sobre la responsabilidad social o ética ligada a la solución que se proponga en cada caso.

CG06 - Haber desarrollado la autonomía suficiente para participar en proyectos de investigación y colaboraciones científicas o tecnológicas dentro de su ámbito temático, en contextos interdisciplinares y, en su caso, con una alta componente de transferencia del conocimiento.

CG07 - Ser capaces de asumir la responsabilidad de su propio desarrollo profesional y de su especialización en uno o más campos de estudio.

CT01 - Uso de la lengua inglesa

CT03 - Creatividad

CT04 - Organización y planificación

## 3.2. Learning outcomes

RA28 - Analizar las diferentes soluciones para la propuesta de una red de comunicaciones.

RA27 - Conocer los mecanismos de comunicación de datos entre máquina, así como de los protocolos básicos que gobiernan los mecanismos de comunicación

RA29 - Conocer las características específicas de las redes de comunicaciones industriales.

\* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

## 4. Brief description of the subject and syllabus

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### 4.1. Brief description of the subject

This subject has been designed towards so that the student is able to know and evaluate different communication systems, with deeper knowledge on the OSI layered model. In addition to this, the practical approach of some parts of the subject allows the student to really follow the information flow throughout all the OSI layers and from generation, transmission and reception. So, the student will be able to see how information flows through physical transmission media, how it is addressed at LAN level, the way packets are routed through a series of networks, identify session protocols and diagnose them, and see how higher layers operate, also.

The first couple of lessons address general concepts such as multiplexing techniques, switching techniques, modulation, transmission types, the concept of encapsulation, etc. After this, several lessons revise in more detail the layers, classified in: a) Ethernet (physical and link layer levels), b) TCP/IP (network and transport), and c) Applications (session, presentation and application itself).

After this travel throughout all layers, other networks are revisited. For instance, wireless networks are covered by two topics: cellular networks (with emphasis on GSM), Wireless LANs (Wifi) and lower power lower rate ones such as Bluetooth and Zigbee, are seen. Another lesson addresses the specific problems of control networks. The CAN protocol is analysed in detail as a widely used control network example.

Esta asignatura tiene un enfoque destinado a que el alumno conozca y sepa evaluar diferentes sistemas de comunicaciones, profundizando en la funcionalidad de las diferentes capas del modelo OSI de comunicaciones. El aspecto práctico de la asignatura permite, además, que el alumno identifique y localice la información en todas las

fases de generación, transmisión y recepción. Así, el alumno puede 'ver' la información tal como viaja por los medios físicos, cómo se direcciona a nivel de red local, el viaje de los datos a través de una sucesión de redes a través de Internet, identificar y diagnosticar los problemas de sesión y de protocolos de nivel superior.

Tras unos primeros temas en los que se cubren aspectos genéricos de las comunicaciones, como técnicas de conmutación, multiplexación, modulación o de paquetes, sin entrar a valorar o analizar redes específicas, y con énfasis en conceptos básicos como el encapsulamiento de la información a través de las capas OSI, se visitan ejemplos muy extendidos en cada una de las capas.

Así pues, se ven características de las redes Ethernet (capas física y de enlace), los protocolos TCP/IP, incluyendo conceptos avanzados como NAT, firewalls y VPNs, o protocolos de sesión tales como el http o el protocolo de correo electrónico (smtp) o el servicio de nombres.

Tras haber visitado ejemplos representativos de cada una de las capas, se desciende de nuevo a los niveles más bajos para revisar aspectos de otras redes. En particular, se estudian conceptos de redes celulares (GSM y otros tipos), y redes inalámbricas (WiFi, Bluetooth, Zigbee)

## 4.2. Syllabus

1. Generic communications concepts /Conceptos generales de comunicaciones
2. The OSI layer model /Modelo de capas OSI
3. Ethernet Networks / Redes Ethernet
4. TCP/IP
5. Network services / Servicios de red
6. Mobile and cellular networks / Redes móviles y celulares
7. Wireless networks / Redes inalámbricas
8. Control networks / Redes de control

## 5. Schedule

### 5.1. Subject schedule\*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1			<b>Generic concepts of communications</b> Duration: 02:00	<b>Continuous evaluation: Attendance, discussions in class and answering to questions</b>  Continuous assessment Presential Duration: 00:00
2			<b>Generic concepts of communications II</b> Duration: 02:00	<b>Continuous evaluation: Attendance, participation in discussions and questions answering</b>  Continuous assessment Presential Duration: 00:00
3			<b>The OSI referece communications model</b> Duration: 02:00	<b>Continuous evaluation: Class attendance, participation in discussions and questions answering</b>  Continuous assessment Presential Duration: 00:00
4			<b>Ethernet Networks</b> Duration: 02:00	<b>Continuous evaluation: Class attendance, participation in discussions and questions answering</b>  Continuous assessment Presential Duration: 00:00
5			<b>Advanced Ethernet: VLANs and QoS</b> Duration: 02:00	<b>Continuous evaluation: Class attendance, participation in discussions and questions answering</b>  Continuous assessment Presential Duration: 00:00
6			<b>Basic TCP/IP</b> Duration: 03:00	<b>Continuous evaluation: Class attendance, participation in discussions and questions answering</b>  Continuous assessment Presential Duration: 00:00

7		<p>Montaje de redes Ethernet. Red del laboratorio. Elementos fundamentales. Duration: 01:00</p> <p>Monitorización de paquetes. Capa MAC y capa IP Duration: 01:00</p> <p>Configuración IP de ordenadores. Monitorización de paquetes (Wireshark). Análisis de direcciones MAC e IP en un rutado indirecto Duration: 01:00</p>	<p>TCP/IP (II) Duration: 02:00</p>	<p>Continuous evaluation: Class attendance, participation in discussions and questions answering</p> <p>Continuous assessment Presential Duration: 00:00</p>
8			<p>Advanced TCP/IP : NAT, firewall, VPN Duration: 02:00</p>	<p>Continuous evaluation: Class attendance, participation in discussions and questions answering</p> <p>Continuous assessment Presential Duration: 00:00</p>
9			<p>Advanced TCP/IP avanzado: NAT, firewall, VPN Duration: 02:00</p>	<p>Continuous evaluation: Class attendance, participation in discussions and questions answering</p> <p>Continuous assessment Presential Duration: 00:00</p>
10		<p>Instalación de router profesional en máquinas virtuales Duration: 03:00</p>	<p>Exercises on network notation and partitioning into subnetworks Duration: 02:00</p>	<p>Continuous evaluation: Class attendance, participation in discussions and questions answering</p> <p>Continuous assessment Presential Duration: 00:00</p>
11			<p>Cellular networks: GSM, professional networks and satellite networks Duration: 02:00</p>	<p>Continuous evaluation: Class attendance, participation in discussions and questions answering</p> <p>Continuous assessment Presential Duration: 00:00</p>
12			<p>Wireless Networks Duration: 00:00</p>	<p>Continuous evaluation: Class attendance, participation in discussions and questions answering</p> <p>Continuous assessment Presential Duration: 00:00</p>
13			<p>Redes inalámbricas II Duration: 02:00</p>	<p>Continuous evaluation: Class attendance, participation in discussions and questions answering</p> <p>Continuous assessment Presential Duration: 00:00</p>



14			Exercises and problems solving Duration: 02:00	Continuous evaluation: <b>Class attendance, participation in discussions and questions answering</b>  Continuous assessment Presential Duration: 00:00
15				<b>Ordinary exam (January)</b>  Continuous assessment and final examination Presential Duration: 02:00
16				
17				

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

\* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

## 6. Activities and assessment criteria

### 6.1. Assessment activities

#### 6.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Continuous evaluation: Attendance, discussions in class and answering to questions		Face-to-face	00:00	10%	0 / 10	
2	Continuous evaluation: Attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	
3	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
4	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
5	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
6	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
7	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01

8	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
9	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
10	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
11	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
12	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
13	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
14	Continuous evaluation: Class attendance, participation in discussions and questions answering		Face-to-face	00:00	10%	0 / 10	CB08 CT03 CB07 CG03 CG06 CT01
15	Ordinary exam (January)		Face-to-face	02:00	100%	4 / 10	CT04 CT03 CE02 CB07 CG02 CG03 CG06 CG07 CB06 CT01

### 6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
15	Ordinary exam (January)		Face-to-face	02:00	100%	4 / 10	CT04 CT03 CE02 CB07 CG02 CG03 CG06 CG07 CB06 CT01

### 6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Extraordinary call exam (June/July)		Face-to-face	02:00	90%	4 / 10	CB08 CT04 CT03 CE02 CB07 CG02 CG03 CG06 CG07 CB06 CT01

## 6.2. Assessment criteria

Continuous evaluation is performed through the whole course, including remote lectures and in-site practical activities. Overall, the weight is 10% of the total score, 90 % remaining is based on an examination.

## 7. Teaching resources

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### 7.1. Teaching resources for the subject

Name	Type	Notes
Class Slides / Apuntes de clase	Bibliography	Apuntes de clase / Slides
IEEE Standards	Web resource	Accessible from University computers only
RFC Documents	Web resource	Public domain documents