

• LEBANESE UNIVERSITY •  
• SAINT JOSEPH UNIVERSITY OF BEIRUT •

**MASTER**  
**Telecoms, Networks and Security**

**Information:**

<http://www.ulfg.ul.edu.lb/master-sections/6>  
<https://fi.usj.edu.lb/esib/ded.html>

**Faculty of Engineering, Lebanese University**  
**Hadath Campus**  
**Tel: (05) 463 489**

**Faculty of Engineering, Saint Joseph University of Beirut (USJ)**  
**Mar Roukos, Mkalles**  
**Tel: (01) 421317**

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## GENERAL INFORMATION

Internet and telecommunications systems today bring a new dimension to our society with technological, economic and sociological challenges. Communication networks and their security as well as their applications are now the subject of numerous initiatives with a strong demand on the job market for specialist engineers and qualified researchers. This will be strengthened in the future with competition amplified by deregulation, the appearance of new professions which require a qualified workforce, as well as by technological and economic developments around services on the Internet and cybersecurity, around mobiles, private networks and telecommunications operators.

## SCIENTIFIC AND EDUCATIONAL OBJECTIVE

The Telecoms, Networks and Security master's degree prepares engineers, network and security researchers to master the global environment linked to telecommunications networks and security issues. For example, students will be able to become researchers in fields such as security expert, design of networks and telecommunications systems, network administration, transmission of multimedia content and the Internet of the future. This Master also motivates students who wish to prepare a doctoral thesis (PhD) in this field.

This Master aims to prepare:

- experts and researchers,
- high-level specialists in network security and cybersecurity needed in the various related administrations and design offices,
- foreign researchers: due to the importance of the problems addressed, opening up to foreign students from the Mediterranean basin can bring about a synergy favorable to better common use of the resource.

It is an inter-university diploma in Lebanon, sanctioning training to which reputable establishments bring their collaboration and their educational and scientific resources.

Two faculties belonging to two Lebanese universities: The **Faculty of Engineering** of the *Lebanese University*, and the **Faculty of Engineering** of *Saint-Joseph University of Beirut* act jointly, under the aegis of the *Ministry of Culture and Higher Education*, to co-enable in partnership with *Télécom ParisTech* the high-level training distributed as part of this Master's degree.

## GENERAL ORGANIZATION OF THE MASTER

The Master consists of 120 credits, spread over 4 semesters of 30 credits each. This program provides 60 credits related to the last two semesters. These two semesters MS1 and MS2 of 30 credits each, include:

- theoretical and practical courses,
- a research internship leading to the writing of a dissertation and the defense in front of a jury.

The internships and research work will take place either in Lebanon in companies or laboratories, or in a laboratory of an external establishment. Scientific responsibility for the internship is ensured jointly by the teacher(s) - researchers who direct the internship. Internships carried out in Lebanon are supervised by the two Lebanese faculties on themes approved by the Master's Monitoring Committee (CS).

This internship, lasting a minimum of one semester (MS2), aims to develop in the student all the skills necessary for a specialist:

- Bibliographic study.
- Critical analysis of the state of the art.
- Proposals and implementation of solutions.
- Proposals and opportunities for thesis work for students who have chosen to continue with a thesis.

The internship is the subject of a written dissertation and a public defense. The dissertation includes a bibliographical part and a technical part.

The internship evaluation takes into account three elements:

- Evaluation of the student's scientific initiative.
- Evaluation of the written dissertation.
- Evaluation of the oral defense.

## **ADMISSION**

Are authorized to submit application files:

- Graduate engineers,
- Holders of a professional or research Master's degree in Electrical Engineering, Networks, Computer Science, Telecommunications,
- Holders of a recognized equivalent diploma.

The selection of candidates is made by an admissions jury within the limits of available places. The admissions jury will decide for each application the subjects and modules validated according to the course and the results previously obtained.

## THE GRADUATION

The Master 2 Research diploma in "**Telecoms, Networks and Security**" is awarded to admitted students who have successfully passed the controls relating to the teaching and the defense of their dissertation, as defined by the internal regulations.

The Master's degree is awarded jointly by the Lebanese University and the Saint Joseph University of Beirut, it is recognized by foreign partner establishments.

## DIPLOMA RULES

### 1. Knowledge check

The Master in **Telecoms, Networks and Security** is awarded to candidates who have successfully passed the tests relating to theoretical and practical lessons and who demonstrate a sufficient level during the preparation and defense of the dissertation. In the event of absence, there is no provision for making up exams. In the event of a serious accident, duly and seriously justified, the case will be examined by the end-of-year jury with a view to taking the measures deemed appropriate.

### 2. Attendance

All teaching activities are compulsory. Checks are periodically carried out. For any subject, if the total of unjustified absences is greater than 30% of the total number of scheduled hours, the student cannot take the test relating to this subject. In this case the student cannot take the exam, obtains a zero grade (ECTS: F). If as a result of this measure, the student misses more than three tests, he or she is considered to have resigned from the Master's program.

### 3. Conditions

Each course is assigned a mark out of 20. A general average of the theoretical modules is calculated from the exam marks of the semester, weighted by the number of credits. A reminder system is applied for any subject where the student obtained a grade lower than 10/20. The student will not make a recall for the course whose grade is between 8 and 10 if the general average is greater than or equal to 11/20. Following the reminders, a jury is assembled and decides on the results.

Theoretical courses are validated if:

- a. the grades of all courses are above ten.
- b. If in certain courses the mark is between 8 and 10, the general average success is 11/20.

Students who have validated the theoretical modules are authorized to present the dissertation. Priority in the choice of internships depends on the general average.

The dissertation is validated if the score is greater than or equal to 12/20.

#### **4. Diploma.**

The studies lead to the delivery of a Master's Diploma in **Telecoms, Networks and Security** , when the candidate validates all the subjects of the 2 semesters MS1 and MS2.

An overall average is established by applying a weighting of 50% for the MS1 semester average and 50% for the MS2 dissertation). Depending on which, the following mentions are granted:

- from 12/20 to 13.99/20: Fairly Good
- from 14/20 to 15.99/20: Good
- from 16/20: Very Good

### **REGISTRATION CONDITIONS**

Admissions are made on file. This will include:

- Certified copies of diplomas obtained <sup>1</sup> including the baccalaureate
- Certified copies of grades obtained during university studies <sup>1</sup> .
- List of lessons followed during schooling.
- Civil status extract.
- Three ID photos bearing the candidate's first and last name on the back.
- Candidate's CV.
- Copy of work certificates and certificate of professional experience of the candidate.

(1)- The candidate is required to present the original documents for verification on the day of registration.

The files will be examined by the CS which will establish the list of candidates admitted to follow this training. Successful candidates may be subject to an interview before final admission. The application file must be collected and submitted to:

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## REGISTRATION FEES

The amount of registration fees for all students is the official amount in Lebanese Pounds at the Lebanese University and 1000 US Dollars at Saint-Joseph University. No refund will be made in the event of withdrawal from studies.

## DOCTORAL STUDIES

Certain students who have obtained their Master's degree with excellent marks will be able to integrate the preparation of a doctoral thesis (in co-supervision between Lebanon and a French-speaking establishment) and submit a request to the AUF or CNRS-L for the obtaining a doctoral thesis scholarship.

## ORGANIZATION OF TEACHING

The subjects of the MS1 and MS2 semesters are:

Coded	Module	C+TPC	Credits
<b>MTRS01S1</b>	<b>Advanced network protocols and services</b>	<b>24h</b>	<b>3</b>
<b>MTRS02S1</b>	<b>Mobile and cellular networks</b>	<b>24h</b>	<b>3</b>
<b>MTRS03S1</b>	<b>Cryptography</b>	<b>18h</b>	<b>3</b>
<b>MTRS04S1</b>	<b>Network modeling</b>	<b>21h</b>	<b>3</b>
<b>MTRS05S1</b>	<b>Optimization for networks</b>	<b>18h</b>	<b>3</b>
<b>MTRS06S1</b>	<b>Cloud and Application Architectures</b>	<b>21h</b>	<b>3</b>
<b>MTRS07S1</b>	<b>Security in networks</b>	<b>18h</b>	<b>3</b>
<b>MTRS08S1</b>	<b>Cybersecurity</b>	<b>24h</b>	<b>3</b>
<b>MTRS09S1</b>	<b>Wireless networks</b>	<b>18h</b>	<b>3</b>
<b>MTRS10S1</b>	<b>Machine Learning for Networks and Cybersecurity</b>	<b>21h.</b>	<b>3</b>
<b>MTRS01S2</b>	<b>Internship report</b>	<b>0h + 300h</b>	<b>30</b>

### **MTRS01S1. Advanced network protocols and services - C+TPC 24h, 3 credits**

Switching, flow and congestion control, error control. Routing protocols (RIP, OSPF, BGP). Addressing and Multipoint Group Management (IGMP). Multipoint routing (DVMRP, PIM). Variants of TCP. Protocols for reliability and congestion control for multipoint. IPv6 evolution. IP mobility. Multihoming and SCTP. Architecture of QoS, IntServ and RSVP, DiffServ, MPLS Service. Quality of service routing, Flow management mechanisms (RED, WFQ, etc.), VoIP.

### **MTRS02S1. Mobile and Cellular Networks - C+TPC 24h, 3 credits**

Cellular concepts and functions in mobile networks; Standardization and evolution of mobile networks; LTE and 4G networks (LTE-Advanced and LTE-Advanced Pro): services, radio interface, physical and protocol architectures, physical, transport and logical channels, voice in LTE, management of data flows, management of radio resources, management of security and developments from LTE to LTE-Advanced and LTE-Advanced Pro; recent advances in mobile networks; dimensioning and radio

planning of 4G networks; mobile network deployment practices; quality of service and optimization of mobile networks; C-RAN; SDN; Cellular Internet of Things.

**MTRS03S1. Cryptography - C+TPC 21h, 3 credits**

Basic of Security Services. History of Cryptography. Symmetric, Asymmetric Algorithms, Hash Functions. Cryptographic Mechanisms and Techniques. Cryptographic Modes. PKCS standards. Envelopes. PKI. Smart Cards. Cryptography and ASN1. Modern (quantum) cryptography. The courses will be given in the cryptographic laboratory with the use of Cryptographic Tools to implement symmetric, asymmetric, hash algorithms, cryptographic modes, cryptographic protocols and security devices.

**MTRS04S1. Network modeling – C+TPC 21h, 3 credits**

Introduction to teletraffic theory. Memoryless source model (Bernoulli and Poisson) and study of multiplexing and multiple access. Discrete-time and continuous-time Markov chains. Introduction to Queuing Theory). Markovian files of type M/M and applications to modeling in networks. Queuing networks. Product form networks. Traffic and traffic aggregation models. Non-Markovian files (M/G/1 and G/M/1). Problems of performance evaluation and modeling of communication systems. Sizing.

**MTRS05S1. Optimization for networks - C+TPC 18h, 3 credits**

Mathematical optimization: formulation of an optimization problem, linear optimization problem, convex non-linear optimization problem, integer optimization problem, non-convex non-linear optimization problem. Search for optimal solution: Lagrangian, duality, optimality conditions, complexity, tools and software for optimization.

Algorithms: simplex, branch and bound, gradient and subgradient, primal and dual decomposition, meta-heuristic. Multi-objective optimization: dominance, scalar method, Pareto criterion and utilitarian criterion. Optimization and game theory: non-cooperative games, utility function and optimization, Nash equilibrium, Best Response algorithm. Application of optimization for networks: routing in networks, network sizing, bandwidth allocation and fairness problems, scheduling in wireless networks, power control in wireless networks, selection of wireless access.

**MTRS06S1. Cloud and Application Architectures - C+TPC 21h, 3 credits**

Cloud Technologies and Services - Cloud Computing, architectures, infrastructures, services, virtualization - Distributed processing and storage - Programming and Application Architectures - Agent and multi-agent systems - Intelligent agents - Peer-to-peer architectures.

**MTRS07S1. Network security - C+TPC 18h, 3 credits**

Network techniques and architectures. Network attacks. Security services and areas. Network security and associated solutions. Tools and equipment (smart cards) for security. Real case studies for network security. Key distribution - PKI - Audit - Components (TPM) - Applications: Ad-hoc networks, RFID, peer-to-peer, electronic directory and messaging, SMIME, etc. Security in fixed and mobile telecom and packet networks (GSM, UMTS, WiMAX).

**MTRS08S1. Cybersecurity - C+TPC 24h, 3 credits**

Introduction to Cybersecurity - Cybersecurity tools and processes, system administration, operating system and database vulnerabilities, types of cyberattacks. Cybersecurity risk analysis. Technical recommendations for cybersecurity.

**MTRS09S1. Wireless networks - C+TPC 18h, 3 credits**

Classification of wireless networks. WLAN networks: architecture, versions, MAC protocol, QoS. Ad hoc networks: self-configuration, proactive and reactive routing, MAC layer. Vehicular networks: requirements and constraints of intelligent transport systems (ITS), V2I and V2V communications, applications, standards, QoS, mobility models. Sensor networks: WSN architecture, clustering and

routing mechanism with energy constraints, low-power communications standards (IEEE 802.15.4, BLE), 6LowPAN and ZigBee. Internet of Things: IoT pillars, IoT elements, IoT applications, communication protocols: MQTT, CoAP, LoRaWAN.

**MTRS10S1. Machine Learning for Networks and Cybersecurity - C+TPC 21h, 3 credits**

Machine Learning, data analysis methods. How-tos for networks and cybersecurity, analysis, what ML can do for cybersecurity, attack detection, prevention, etc.

**MTRS01S2 Internship dissertation C 0 h, TPC 300 h, 30 credits**

It constitutes an introduction to research techniques. It is the synthesis of six months of research work in a company, a research center or a laboratory.