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## International Master of Science on Cyber Physical Systems

### *Evaluation of existing courses and identification of needed courses*

***D1.1***

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## Disclaimer

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# 1 Introduction

This deliverable reports on the systematic review of existing computer science master courses, along with information on the structure of the programs, possible standards and guidelines. Every partner analysed the status quo (existing materials, materials used in courses, existing environment, skills, but also development perspectives and expectations). A common analysis and requirements report for creation/adaptation of courses is presented.

## 1.1 Scope

The scope of this deliverable is the existing master programs curricula in partner countries. This deliverable explores these programs in order to find related modules to the Cyber Physical Systems Program (CPSP). The deliverable will also help the partners to identify the core course structure, capacity needed and modules of the intended program.

## 1.2 Relation to deliverables

This deliverable will act as the first milestone for WP1 that is concerned in outlining the framework for potential courses for the intended CPSP. This will serve as a starting point for identifying the courses to be used in conjunction with the finding of the next deliverable that identifies market needs for such program.

## 1.3 Relation to work packages

This deliverable will act as a milestone for WP2 that is concerned in the development of the program structure and modules. This deliverable will outline the initial requirements and the basis of the CPSP.

## 1.4 Terminology

CPSP: Cyber Physical System Program

IoT: Internet of Things

Modules/courses: These are used interchangeably to indicate a unit of the program to be implemented.

Partner Countries: Countries where the program to be implemented (Palestine, Tunisia, Jordan)

Program Countries: EU partners (Germany, Sweden, UK)

Program: The master program (CPSP) to be implemented

## 2 Methodology

In order to explore the existing computer science programs that are related to the CPSP, two surveys were designed (see Annex 1 and Annex 3). These surveys were analysed and compared with existing CPSP programs in different countries.

As a result of the analysis, main potential courses for the program to be proposed. Such list of courses will be refined after discussion and review by all partners. This will be concluded with a list of the core courses and structure of the intended program.

## 3 Survey Analysis

In this section we provide an overview of the survey that was conducted and present its findings and results.

### 3.1 Survey Overview

The purpose of the survey that can be seen in Annex 1 is to help to identify the potential courses and the program structure in every partner country where the program to be implemented. The survey contains four sections; Potential courses, market requirement, courses and staff expertise, and program structure and future prospective. The first section contains two parts; part one contains a list of courses that are related to CPSP, partners are asked to indicate if such courses exist in one of the programs offered in their perspective country and state whether expertise for such courses exist to teach such course; the second part contains a table to be filled by partners to add potential courses that do not exist in the first part.

The second section is intended for the market analysis; this will be used in deliverable D1.2. The third section is intended for the third deliverable D1.3.

All partners were asked to fill an additional table for similar programs around the world. This is to be used to learn more about CPSP that exists in other countries and be able to learn from such programs.

### 3.2 Survey Results

In this subsection we summarize the results of the survey filled by each partner country, actual filled surveys can be found in the subdirectory "Similar-Programmes-Survey" under documents of workpackage1 folder in the shared workspace for the MSCP project.

We also look at the similar programs and the courses taught for such programs and propose the list of commonly recommended courses.

#### 3.2.1 Jordan

The two partner universities in Jordan filled the survey. Looking at the filled surveys, we found that the following courses exist in Jordan:

***Topics in Embedded Software and Systems, Digital Systems Architecture, Advanced Real-Time Systems, Network Security, Microcontrollers, Control Systems I, Control Systems II, Linear Control Theory, Adaptive Control, Non-linear Control Theory, Intelligent Systems and Robotics Transportation System Design, Traffic Engineering, Computer Graphics, Digital Image Processing and Analysis, Advanced Computer Graphics, Computer Vision, Advanced Topics in Computer***

***Science {Advanced Visual Computing}, Computer Systems Security, Topics in Computer Science {Advanced Computer Security}, Computer Networks, Computer Controlled Systems.***

And the suggested extra courses are as follows:

***The Internet of things, Wireless sensor networks, Cloud and fog computing, Big Data, Vehicular communications, mobile and ubiquitous computing.***

### 3.2.2 Palestine

The two partner universities in Palestine filled the survey. Looking at the filled surveys, we found that the following courses exist in Palestine:

***Control Systems I, Control Systems II, Linear Control Theory, Adaptive Control, Non-linear Control Theory, Robotics, Intelligent Systems and Robotics, Introduction to Robotics, Project Management and Leadership, Computer Graphics, Digital Image Processing and Analysis, Computer Systems Security, Computer Networks, Introduction to Robotic Systems, Computer Controlled Systems, Nonlinear Control Systems, Introduction to Machine Learning and Applications, Modelling and Control of Power Electronics and Electric Vehicle Powertrains, Introduction to Machine Learning and Applications.***

And the suggested extra courses are as follows:

***Cloud Computing, Data Analytics, and Internet of Things.***

### 3.2.3 Tunisia

The two partner universities in Tunisia filled the survey. Looking at the filled surveys, we found that the following courses exist in Tunisia:

***Introduction to Cyber-Physical Systems, Discrete-Event Systems: Supervisory Control and Diagnosis, - Foundations of Hybrid and Embedded Systems, Topics in Embedded Software and Systems, Model-Integrated Computing, Systems Theory, Cyber-Physical Systems, Digital Systems Architecture, Advanced Real-Time Systems, Engineering Design of CPS, Data Analytics for Engineers, Probabilistic Methods in Engineering Design, Engineering Design Optimization, Uncertainty Quantification, Design of Electromechanical Systems, Dependable and Trustworthy CPS, Reliability and Risk Case Study, Risk and Decision Analysis, Network Security, Automated Verification, System-Level Fault Diagnosis, Embedded Systems, Microcontrollers, Embedded Systems, Control Engineering, Control Systems I, Control Systems II, Linear Control Theory, Adaptive Control, Non-linear Control Theory, Robotics, Intelligent Systems and Robotics, Introduction to Robotics, Robot Manipulators, Transportation Engineering, Transportation System Design, Traffic Engineering, Biomedical Engineering, Principles and Applications of BioMEMS, Therapeutic Bioengineering, Advanced Computational Modelling and Analysis, Smart Health Technology, Quantitative Methods, Project Management and Leadership, Engineering Leadership, Biomedical Instrumentation, Introduction to Machine Learning and Applications, Computer Graphics, Digital Image Processing and Analysis, Advanced Computer Graphics, Topics in Computer Science {3D Graphical and Geometric Modelling}, Introduction to Micro and Nano Electromechanical Systems, Smart Sensor Technology I: Design, Machine Learning, Computer Vision, Advanced Topics in Computer Science {Advanced Visual Computing}, Smart Sensor Technology II: Characterization and Fabrication, Biomedical Microsystems, Computer Systems Security, Computational Modelling of Complex Systems, Special Topics in Computer Science {Cyber Security Practice}, Real-Time and Embedded Operating Systems, Topics in Computer Science {Embedded Networking}, Topics in Computer Science {Advanced Computer Security}, Embedded System Design, Computer Networks, Advanced Computer Security, Advanced Topics in Computer Science {Embedded Wireless Networking for Cyber-Physical Systems}, Real-Time Scheduling for Cyber-Physical Systems, Special***

**Topics in Electrical and Computer Engineering II {Information Theory and Reliable Communication}, :Special Topics in Electrical and Computer Engineering II {Microwave Engineering}, {Mixed-Signal and RF Integrated Circuits}, Introduction to Robotic Systems, Computer Controlled Systems, Control systems II, Medical Robotics and Systems, Nonlinear Control Systems, Control of Discrete Event Systems, Dynamic Systems and Optimal Control, Special Topics in Civil Engineering/Special Topics in Civil Engineering II {Intelligent Transportation Systems}, Introduction to Machine Learning and Applications, Advanced Topics in Computer Science {Embedded Wireless Networking for Cyber-Physical Systems}, Introduction to Machine Learning and Applications, Modelling and Control of Power Electronics and Electric Vehicle Powertrains, Electrical Energy System Engineering, Machine Learning, Operation and Control of Modern Power Systems, Biomedical Instrumentation, Introduction to Machine Learning and Applications, Introduction to Micro and Nano Electromechanical Systems, Smart Sensor Technology I: Design, Smart Sensor Technology II: Characterization and Fabrication, Medical Robotics and Systems,**

And the suggested extra courses are as follows:

**Internet of Things, and Arduino Programming.**

### 3.2.4 International

The program countries partners pointed to a number of similar MSCP programs that are found internationally. The list of programs are shown in the following table:

*Table 1: International MSCP programs*

University Name	Country	Program Title	Web Page
University of Oxford	UK	Cyber Physical Systems	<a href="https://www.cs.ox.ac.uk/research/cyberphysical/">https://www.cs.ox.ac.uk/research/cyberphysical/</a>
MINES Saint-Étienne	France	Cyber-Physical and Social Systems	<a href="https://www.emse.fr/~picard/cours/cps2/">https://www.emse.fr/~picard/cours/cps2/</a>
Deggendorf Institute of Technology	Germany	Mechatronic and Cyber-Physical Systems	<a href="https://www.th-deg.de/en/tc-cham-en/courses/master-mechatronic-and-cyber-physical-systems">https://www.th-deg.de/en/tc-cham-en/courses/master-mechatronic-and-cyber-physical-systems</a>
Hochschule Emden/Leer - University of Applied Sciences	Germany	Industrial Informatics - Specialisation Industrial Cyber-Physical Systems	<a href="https://www.hs-emden-leer.de/studieren/studienangebot/alle-studiengaenge/industrial-informatics/">https://www.hs-emden-leer.de/studieren/studienangebot/alle-studiengaenge/industrial-informatics/</a>
Università della Svizzera italiana	Switzerland	Cyber-Physical and Embedded Systems (MCPES)	<a href="https://www.usi.ch/en/mcpes">https://www.usi.ch/en/mcpes</a>
Vanderbilt School of Engineering	USA	Cyber-Physical Systems	<a href="https://engineering.vanderbilt.edu/academics/meng/CPS/index.php">https://engineering.vanderbilt.edu/academics/meng/CPS/index.php</a>

<b>University of California</b>	USA	Embedded And Cyber-physical Systems	<a href="https://mecps.uci.edu/">https://mecps.uci.edu/</a>
<b>University Registrar</b>	USA	EMBEDDED CYBER PHYSICAL SYSTEMS	<a href="https://www.reg.uci.edu/fees/2018-2019/embeddedsystems.html">https://www.reg.uci.edu/fees/2018-2019/embeddedsystems.html</a>
<b>University of Warwick</b>	UK	Cyber-Physical Systems	<a href="https://warwick.ac.uk/fac/sci/wmg/education/wmgmasters/structure/modules/cps">https://warwick.ac.uk/fac/sci/wmg/education/wmgmasters/structure/modules/cps</a>
<b>ITMO University</b>	Russia	Control of Cyber-Physical Systems	<a href="http://en.itmo.ru/en/viewjep/2/69/Control_of_Cyber-Physical_Systems.htm">http://en.itmo.ru/en/viewjep/2/69/Control_of_Cyber-Physical_Systems.htm</a>
<b>HSE Tikhonov Moscow Institute of Electronics and Mathematics (MIEM HSE)</b>	Russia	Internet of Things and Cyber-physical Systems	<a href="https://www.hse.ru/en/ma/internet/about/">https://www.hse.ru/en/ma/internet/about/</a>



## 4 Analysis and Conclusion

After reviewing the input of all partner countries and comparing it with the existing programmes world wide, the findings were summarised in table 2. In the first three columns, the courses taught at the international programmes, and the rest of the columns identify the existence of the courses in these programmes in partner countries seeking to implement similar programmes.

Table 2: Summary of serving existing international MCSP and existing courses at partner countries.

University	Vanderbilt University	University of Lyon	Università della Svizzera italiana	University of Siegen		Al-Quds University	Jordan University of Science and Technology	German Jordanian University		all universities	
Country	USA	France	Italy	Germany		Palestine	Jordan	Jordan		Tunis	
Program name	Master of Engineering Degree Program in Cyber-Physical	Master Program on Cyber-Physical and Social Systems (CPS2)	Master in Cyber-Physical and Embedded Systems			Electronics and Computer Engineering					
Program Level	MA	MA	MA	BA	MA	MA	BA	BA	MA	BA	MA
Required Credit Hours / ECTS	30 CH	Two years, 2 semesters each year (121 ECTS)	Two years, 2 semesters each year (120 ECTS)			36 CH					
Courses											
Cyber-Physical Systems	Required			x							
Embedded Systems	Elective		Required	x				x	x	x	
Embedded System Modeling and Design				x	x						
Foundations of Hybrid and Embedded Systems	Required			x							
Intelligent Systems and Robotics	Elective	M1 (Theoretical)			x	x		x		x	
Machine Learning			Elective		x	x					x
Engineering Leadership and Program Management	Elective	M1 (International project Management)	Required								
Advanced Real-Time Systems	Required		Required		x				x	x	
Sensors, Actuators and Sensor Networks				x	x						
Cloud Computing		M2 (Cyber)		x							
Mobile Computing		M2 (Cyber and Physical)	Required								
Internet of Things		M2 (Physical)									
Security & Privacy in CPS	Elective	Two courses (Security M1 Socail and Cyber, M2 Trust and Privacy)	Required	x	x						
System-Level Fault Diagnosis	Elective										x
Reliability and Risk Analysis	Elective			x							x
Probabilistic Methods in Engineering Design	Elective										
Uncertainty Quantification	Elective										
Discrete-Event Systems: Supervisory Control and Diagnosis	Required			x							x
Optimization and Operational Research		M1 (Theoretical)									
Advanced Modeling and Simulation		M1 (Theoretical)		x	x						
Data Analytics for Engineers	Elective	M1 (Theoretical)		x	x						
Advanced Computational Modeling and Analysis		M1 (Theoretical) (Complexity)		x	x						
Reprogrammable Systems			Elective								
Advanced Algorithmics and Programming		M1 (Theoretical)									
Multi-Agent Programming		M2 (Theoretical)									
Validation and Verification	Elective										
Software Engineering				x	x	x					
Specification Languages											
Systems Theory	Required										x
Microcontrollers	Elective			x				x		x	
Control Systems for Cyber-physical Systems	Elective										
Control Theory	Elective			x	x	x	x	x			x
Smart Health Technology				x							
Transportation System Design	Elective			x			x	x			
Nanosystems: Devices and Design			Required	x							
Digital Systems Architecture	Required			x							
Virtual Reality/Augmented Reality						x					
Virtual Communities		M1 (Socail)									
Semantic Web		M2 (Cyber and Physical)									

After analysing table 2, and comparing the different international programs with what is offered at the program and partner countries, the following list of courses is proposed, this list are divided into two lists: Core courses (Table 3) and elective courses (Table 4).

*Table 3: Initial list of proposed core courses*

<b>Core Courses</b>	
1	Internet of Things
2	Embedded Systems
3	Intelligent Systems and Robotics
4	Real-Time Systems
5	Cloud Computing and Semantic Web
6	Security & Privacy in CPS
7	Data Analytics for Engineers
8	Multiagent Systems
9	Ubiquitous Computing
10	Knowledge Management
11	Image Processing
12	Optimization

*Table 4: Initial list of proposed elective courses*

<b>Elective Courses</b>	
1	Sensors, Actuators and Sensor Networks
2	Mobile Computing
3	Reliability and Risk Analysis
4	Advanced Computational Modelling and Analysis
5	Systems Theory
6	Microelectronics
7	Microcontrollers
8	Control Systems for Cyber-physical Systems
9	Control Theory
10	Smart Health Technology
11	Transportation System Design
12	Nano Systems: Devices and Design
13	Heterogeneous Multicore Architectures
14	Digital Systems Architecture
15	Virtual Reality/Augmented Reality

The above proposed courses is an initial list of courses that will be reviewed by partners and will be tuned and adjusted to the context of each partner country where the program to be implemented.

It is suggested that the elective courses can be parcelled into groups that form a track of specialisation if needed.

## Annex 1: Survey

This survey is intended to guide us in the program design, it contains four sections:

- 1- Potential courses
- 2- Market requirement
- 3- Courses and Staff Expertise
- 4- Programme Structure and Future Prospective

Please fill these parts of the survey according to you knowledge and experience.

Thank you for your help and cooperation.

### A- Potential Courses

#### A-1: Existing courses and expertise that can be related to the proposed Master degree program

Please cite if any of this courses taught in your university	Level of courses		Academic staff expertise existence			
	Yes	NO	BA	MA	Yes	NO
Introduction to Cyber-Physical Systems						
Discrete-Event Systems: Supervisory Control and Diagnosis						
- Foundations of Hybrid and Embedded Systems						
Topics in Embedded Software and Systems						
Model-Integrated Computing						
Systems Theory						
Cyber-Physical Systems						
Digital Systems Architecture						
Advanced Real-Time Systems						
<i>Engineering Design of CPS</i>						
Data Analytics for Engineers						
Probabilistic Methods in Engineering Design						
Engineering Design Optimization						
Uncertainty Quantification						
Design of Electromechanical Systems						
<i>Dependable and Trustworthy CPS</i>						
Reliability and Risk Case Study						
Risk and Decision Analysis						
Network Security						
Automated Verification						
System-Level Fault Diagnosis						
<i>Embedded Systems</i>						
Microcontrollers						
Embedded Systems						
<i>Control Engineering</i>						
Control Systems I						
Control Systems II						
Linear Control Theory						
Adaptive Control						
Non-linear Control Theory						
<i>Robotics</i>						
Intelligent Systems and Robotics						
Introduction to Robotics						
Robot Manipulators						

<b>Transportation Engineering</b>					
Transportation System Design					
Traffic Engineering					
<b>Biomedical Engineering</b>					
Principles and Applications of BioMEMS					
Therapeutic Bioengineering					
Advanced Computational Modeling and Analysis					
Smart Health Technology					
Quantitative Methods					
<b>Project Management and Leadership</b>					
Engineering Leadership					
Biomedical Instrumentation					
Introduction to Machine Learning and Applications					
Computer Graphics					
Digital Image Processing and Analysis					
Advanced Computer Graphics					
Topics in Computer Science {3D Graphical and Geometric Modeling}					
Introduction to Micro and Nano Electromechanical Systems					
Smart Sensor Technology I: Design					
Machine Learning					
Computer Vision					
Advanced Topics in Computer Science {Advanced Visual Computing}					
Smart Sensor Technology II: Characterization and Fabrication					
Biomedical Microsystems					
Computer Systems Security					
Computational Modeling of Complex Systems					
Special Topics in Computer Science {Cyber Security Practice}					
Real-Time and Embedded Operating Systems					
Topics in Computer Science {Embedded Networking}					
Topics in Computer Science {Advanced Computer Security}					
Embedded System Design					
Computer Networks					
Advanced Computer Security					

Advanced Topics in Computer Science {Embedded Wireless Networking for Cyber-Physical Systems}					
Real-Time Scheduling for Cyber-Physical Systems					
Special Topics in Electrical and Computer Engineering II {Information Theory and Reliable Communication}					
:Special Topics in Electrical and Computer Engineering II {Microwave Engineering}					
{Mixed-Signal and RF Integrated Circuits}					
Introduction to Robotic Systems					
Computer Controlled Systems					
Control systems II					
Medical Robotics and Systems					
Nonlinear Control Systems					
Control of Discrete Event Systems					
Dynamic Systems and Optimal Control					
Special Topics in Civil Engineering/Special Topics in Civil Engineering II {Intelligent Transportation Systems}					
duction to Machine Learning and Applications					
Advanced Topics in Computer Science {Embedded Wireless Networking for Cyber-Physical Systems}					
Introduction to Machine Learning and Applications					
Modeling and Control of Power Electronics and Electric Vehicle Powertrains					
Electrical Energy System Engineering					
Machine Learning					
Operation and Control of Modern Power Systems					
Biomedical Instrumentation					
Introduction to Machine Learning and Applications					
Introduction to Micro and Nano Electromechanical Systems					
Smart Sensor Technology I: Design					
Smart Sensor Technology II: Characterization and Fabrication					
Medical Robotics and Systems					



2- What capacity building skills your staff needs to meet the requirements of the CPS MA program.(Training needs of existing staff in the organizations towards MA CPS)

3-Training needs of existing staff in the organizations towards M.Sc in CPS.

### **D- Programme Structure and Future Prospective**

if you are specialist in the proposed domain please answer these questions

1. Need for and Job requirements of new M.Sc. of CPS
2. Experience of hiring Staff with M.Sc. of CPS
3. Training needs of existing staff in the organizations towards M.Sc. of CPS
4. Requirement of M.Sc. of CPS graduates for employment in the coming five years.
5. Major skills the graduates are expected to have when they complete the M.Sc. of CPS
6. Program structure for M.Sc. of CPS
7. Courses requirements for the M.Sc. of CPS program
8. Requirements of additional managerial and technical skill
9. Length (Duration) of the M.Sc. degree program in CPS
10. Option and justification for online learning mode
11. Emerging or new topics to be addressed at the M.Sc. of CPS.
12. Problem areas/challenges that need to be addressed through research endeavors at M.Sc. CPS
13. Interpersonal/community engagement skills training may be required by the graduates.
14. Additional training to be introduced in the training to produce graduates that are desired by Employers.
15. Professionals/industries that should be involved in the design and future revision of courses in the proposed M.Sc. of CPS

16. Ways in which organizations might support employees registered for the M.Sc. of CPS.

17. Additional remark forwarded in relation to the proposed M.Sc. of CP



Annex 2: Detailed Results

These can be found in the subdirectory of Similar-Programs under the document folder in workpackage1 folder in the shared workspace for the MSCP project

A2.1 Jordan

**TTU Survey**

**This survey is intended to guide us in the program design, it contains four sections:**

- 1- Potential courses**
- 2- Market requirement**
- 3- Courses and Staff Expertise**
- 4- Programme Structure and Future Prospective**

**Please fill these parts of the survey according to you knowledge and experience. Thank you for your help and cooperation.**

**A- Potential Courses**

**A-1: Existing courses and expertise that can be related to the proposed Master**

Please cite if any of this courses taught in your university	Level of courses		Academic staff expertise existence			
	Yes	NO	BA	MA	Yes	NO
Introduction to Cyber-Physical Systems		x				
Discrete-Event Systems: Supervisory Control and Diagnosis		x				
- Foundations of Hybrid and Embedded Systems		x				
Topics in Embedded Software and Systems		x				
Model-Integrated Computing		x			Yes	
Systems Theory		x				
Cyber-Physical Systems		x				
Digital Systems Architecture		x				
Advanced Real-Time Systems		x				
<i>Engineering Design of CPS</i>						
Data Analytics for Engineers		x				
Probabilistic Methods in Engineering Design		x				
Engineering Design Optimization		x				
Uncertainty Quantification		x				
Design of Electromechanical Systems		x				
<i>Dependable and Trustworthy CPS</i>						
Reliability and Risk Case Study		x				
Risk and Decision Analysis		x				
Network Security	x		x		Yes	
Automated Verification		x				
System-Level Fault Diagnosis		x				
<i>Embedded Systems</i>						
Microcontrollers		x				
Embedded Systems		x				
<i>Control Engineering</i>						
Control Systems I	x		x			
Control Systems II	x		x			
Linear Control Theory	x		x		Yes	
Adaptive Control	x		x		Yes	
Non-linear Control Theory	x		x		Yes	
<i>Robotics</i>						
Intelligent Systems and Robotics		x				
Introduction to Robotics		x				
Robot Manipulators		x				
<i>Transportation Engineering</i>						
Transportation System Design	x		x		Yes	
Traffic Engineering	x		x		Yes	
<i>Biomedical Engineering</i>						
Principles and Applications of BioMEMS		x				
Therapeutic Bioengineering		x				
Advanced Computational Modeling and Analysis		x				
Smart Health Technology		x				
Quantitative Methods		x				

**GJU Survey**

This survey is intended to guide us in the program design, it contains four sections:

- 1- Potential courses
- 2- Market requirement
- 3- Courses and Staff Expertise
- 4- Programme Structure and Future Prospective

Please fill these parts of the survey according to you knowledge and experience. Thank you for your help and cooperation.

**A- Potential Courses**

**A-1: Existing courses and expertise that can be related to the proposed Master**

Please cite if any of this courses taught in your university	Level of courses		Academic staff expertise existence			
	Yes	NO	BA	MA	Yes	NO
Introduction to Cyber-Physical Systems		x				
Discrete-Event Systems: Supervisory Control and Diagnosis		x				
- Foundations of Hybrid and Embedded Systems		x				
Topics in Embedded Software and Systems		x				
Model-Integrated Computing		x			Yes	
Systems Theory		x				
Cyber-Physical Systems		x				
Digital Systems Architecture		x				
Advanced Real-Time Systems		x				
<i>Engineering Design of CPS</i>						
Data Analytics for Engineers		x				
Probabilistic Methods in Engineering Design		x				
Engineering Design Optimization		x				
Uncertainty Quantification		x				
Design of Electromechanical Systems		x				
<i>Dependable and Trustworthy CPS</i>						
Reliability and Risk Case Study		x				
Risk and Decision Analysis		x				
Network Security	x		x		Yes	
Automated Verification		x				
System-Level Fault Diagnosis		x				
<i>Embedded Systems</i>						
Microcontrollers		x				
Embedded Systems		x				
<i>Control Engineering</i>						
Control Systems I	x		x			
Control Systems II	x		x			
Linear Control Theory	x		x		Yes	
Adaptive Control	x		x		Yes	
Non-linear Control Theory	x		x		Yes	
<i>Robotics</i>						
Intelligent Systems and Robotics		x				
Introduction to Robotics		x				
Robot Manipulators		x				
<i>Transportation Engineering</i>						
Transportation System Design	x		x		Yes	
Traffic Engineering	x		x		Yes	
<i>Biomedical Engineering</i>						
Principles and Applications of BioMEMS		x				
Therapeutic Bioengineering		x				
Advanced Computational Modeling and Analysis		x				
Smart Health Technology		x				
Quantitative Methods		x				

## A2.2 Palestine

This survey is intended to guide us in the program design, it contains four sections:

- 1- Potential courses
- 2- Market requirement
- 3- Courses and Staff Expertise
- 4- Programme Structure and Future Prospective

Please fill these parts of the survey according to you knowledge and experience.  
Thank you for your help and cooperation.

### A- Potential Courses

#### A-1: Existing courses and expertise that can be related to the proposed Master

Please cite if any of this courses taught in your university	Level of courses		Academic staff expertise existence			
	Yes	NO	BA	MA	Yes	NO
Introduction to Cyber-Physical Systems		x				
Discrete-Event Systems: Supervisory Control and Diagnosis		x				
- Foundations of Hybrid and Embedded Systems		x				
Topics in Embedded Software and Systems		x				
Model-Integrated Computing		x			Yes	
Systems Theory		x				
Cyber-Physical Systems		x				
Digital Systems Architecture		x				
Advanced Real-Time Systems		x				
<i>Engineering Design of CPS</i>						
Data Analytics for Engineers		x				
Probabilistic Methods in Engineering Design		x				
Engineering Design Optimization		x				
Uncertainty Quantification		x				
Design of Electromechanical Systems		x				
<i>Dependable and Trustworthy CPS</i>						
Reliability and Risk Case Study		x				
Risk and Decision Analysis		x				
Network Security	x		x		Yes	
Automated Verification		x				
System-Level Fault Diagnosis		x				
<i>Embedded Systems</i>						
Microcontrollers		x				
Embedded Systems		x				
<i>Control Engineering</i>						
Control Systems I	x		x			
Control Systems II	x		x			
Linear Control Theory	x		x		Yes	
Adaptive Control	x		x		Yes	
Non-linear Control Theory	x		x		Yes	
<i>Robotics</i>						
Intelligent Systems and Robotics		x				
Introduction to Robotics		x				
Robot Manipulators		x				
<i>Transportation Engineering</i>						
Transportation System Design	x		x		Yes	
Traffic Engineering	x		x		Yes	
<i>Biomedical Engineering</i>						
Principles and Applications of BioMEMS		x				
Therapeutic Bioengineering		x				
Advanced Computational Modeling and Analysis		x				
Smart Health Technology		x				
Quantitative Methods		x				

## A2.3 Tunisia

This survey is intended to guide us in the program design, it contains four sections:

- 1- Potential courses
- 2- Market requirement
- 3- Courses and Staff Expertise
- 4- Programme Structure and Future Prospective

Please fill these parts of the survey according to you knowledge and experience.  
Thank you for your help and cooperation.

## A- Potential Courses

## A-1: Existing courses and expertise that can be related to the proposed Master

Please cite if any of this courses taught in your university	Level of courses		Academic staff expertise existence			
	Yes	NO	BA	MA	Yes	NO
Introduction to Cyber-Physical Systems		x				
Discrete-Event Systems: Supervisory Control and Diagnosis		x				
- Foundations of Hybrid and Embedded Systems		x				
Topics in Embedded Software and Systems		x				
Model-Integrated Computing		x			Yes	
Systems Theory		x				
Cyber-Physical Systems		x				
Digital Systems Architecture		x				
Advanced Real-Time Systems		x				
<i>Engineering Design of CPS</i>						
Data Analytics for Engineers		x				
Probabilistic Methods in Engineering Design		x				
Engineering Design Optimization		x				
Uncertainty Quantification		x				
Design of Electromechanical Systems		x				
<i>Dependable and Trustworthy CPS</i>						
Reliability and Risk Case Study		x				
Risk and Decision Analysis		x				
Network Security	x		x		Yes	
Automated Verification		x				
System-Level Fault Diagnosis		x				
<i>Embedded Systems</i>						
Microcontrollers		x				
Embedded Systems		x				
<i>Control Engineering</i>						
Control Systems I	x		x			
Control Systems II	x		x			
Linear Control Theory	x		x		Yes	
Adaptive Control	x		x		Yes	
Non-linear Control Theory	x		x		Yes	
<i>Robotics</i>						
Intelligent Systems and Robotics		x				
Introduction to Robotics		x				
Robot Manipulators		x				
<i>Transportation Engineering</i>						
Transportation System Design	x		x		Yes	
Traffic Engineering	x		x		Yes	
<i>Biomedical Engineering</i>						
Principles and Applications of BioMEMS		x				
Therapeutic Bioengineering		x				
Advanced Computational Modeling and Analysis		x				
Smart Health Technology		x				
Quantitative Methods		x				

## Annex 3: Similar Programmes

This is a screen shot for similar programmes in Jordan, the actual list for all partners can be found in the subdirectory of Similar-Programs under the document folder in workpackage1 folder in the shared workspace for the MSCP project.

Workpackage 1 Similar-Programs Edit Workbook Print Exit Shar

	A	B	C	D	E	F	G
	ID	University name	Responsible Party	City	Country	Title of the similar program	Webpage
1	JO001	Balqa Applied University- Ajloun College	TTU	Ajloun	Jordan	n.a.	
2	JO002	Ajloun National University	TTU	Ajloun	Jordan	n.a.	
3	JO003	Al-Ahliyya Amman University	TTU	Amman	Jordan	n.a.	
4	JO004	Al-Isra University	TTU	Amman	Jordan	n.a.	
5	JO005	Al-Zaytoonah University of Jordan	TTU	Amman	Jordan	n.a.	
6	JO006	Amman Arab University	TTU	Amman	Jordan	n.a.	
7	JO007	Applied Science Private University	TTU	Amman	Jordan	n.a.	
8	JO008	Arab Academy for Banking and Financial Sciences	TTU	Amman	Jordan	Closed	
9	JO009	Arab Open University	TTU	Amman	Jordan	n.a.	
10	JO010	Columbia University: Amman Branch	TTU	Amman	Jordan	n.a.	
11	JO011	German-Jordanian University: Jabal-Amman Branch	TTU	Amman	Jordan	n.a.	
12	JO012	German-Jordanian University: Almushaqar campus/Main Campus	TTU	Madaba	Jordan	n.a.	
13	JO013	Jordan Academy for Maritime Studies	TTU	Amman	Jordan	n.a.	
14	JO014	Jordan Academy of Music	TTU	Amman	Jordan	n.a.	
15	JO015	Jordan Institute of Banking Studies	TTU	Amman	Jordan	n.a.	
16	JO016	Jordan Media Institute	TTU	Amman	Jordan	n.a.	
17	JO017	Middle East University	TTU	Amman	Jordan	n.a.	
18	JO018	Petra University	TTU	Amman	Jordan	n.a.	
19	JO019	Philadelphia University	TTU	Amman	Jordan	n.a.	
20	JO020	Princess Sumaya University for Technology	TTU	Amman	Jordan	n.a.	
21	JO021	Queen Noor Civil Aviation Technical College	TTU	Amman	Jordan	n.a.	
22	JO022	Tafila Technical University	TTU	Tafila	Jordan	n.a.	
23	JO023	The World Islamic Science & Education University (W.I.S.E)	TTU	Amman	Jordan	n.a.	
24	JO024	University of Jordan	TTU	Amman	Jordan	n.a.	
25	JO025	Aqaba University of Technology (2011)	TTU	Aqaba	Jordan	n.a.	
26	JO026	Institute of Banking Studies: Aqaba Branch	TTU	Aqaba	Jordan	n.a.	
27	JO027	Aqaba Campus of the University of Jordan	TTU	Aqaba	Jordan	n.a.	
28	JO028	Balqa Applied University (Salt)	TTU	Aqaba	Jordan	n.a.	