DeCAIR:
Developing Curricula for Artificial Intelligence and Robotics

Task WP2.1 Report

Activity Information

Work Package	WP2 – Development of New M.Sc. and B.Sc. Programs in AI and Robotics
Task	2.1 Title: Defining the structure of the new master and bachelor programs in terms of curricula based on the surveys' results.
Activity Coordinator	Francesco Masulli (UNIGE)
Participating Partners	All
Objective(s)	(a) Definition of the the structure of the curriculum in the master and bachelor programs to be established in UJ and TTU and robotics in JO on the basis of the findings that are identified in WP1 report. (b) Forming two focus groups, one for AI and the other for robotics, that will be responsible for designing the syllabi the content of the courses in AI and robotics in the new program.
Due Date	May 20th (extended)

Description

On the basis of the findings that are identified in WP1 report, TTU and UJ shared with all partners the documents related the proposed structure of their to their new programs: B. Sc. Program in AI and Robotics at the Tafila Technical University and M. Sc. Program in AI and Robotics at the University of Jordan (see the two proposals in Annexes 1a, 1b, 1c and Annex 2).

Then instead of the 3-day meeting in Genoa, which could not be organized due to the pandemic, two virtual meetings involving representatives from all partners were organized on the Zoom platform on 20 Apr 2021 and 7 May 2021 (see the agenda in Annex 3).

The virtual meetings started with a through communication and discussion the findings of WP1 report and then with the presentation B.Sc. and M. Sc. programs in Jordan, the through presentation of the proposed structures of the B. Sc. Program in AI and Robotics at TTU and of the M. Sc. Program in AI and Robotics at UJ. Then followed an in-depth discussion of the two proposals with contributions from the various partners.

After the meetings the partners were invited to report their comments on two feedback forms (see Annexes 4 and 5), and TTU amd UJ prepared a modified structure of their proposed B. Sc. and M. Sc. in AIR (see Annexes 6a, 6b, 6c, and 7).

The structure of programs depicted at the conclusion of WP2.1 will be the input for WP2.2, and but can still be changed during the detailed analysis the syllabi and content of the courses in the new programs that will be carried out in that task.

Moreover, in WP2.1 two focus groups were also formed, one for AI and the other for robotics, based on the expertise of consortium members (see Annexes 8 and 9). These groups will be responsible for designing the syllabi and the content of the adopted courses in AI and robotics in the new programs in WP2.2. The leaders of the focus groups for task WP2.2 are:

- AI Focus Group: Murad Alaqtash
- Robotics Focus Group: Musa Alyaman

1ANNEX 1a

Intelligent Systems Engineering, B.Sc.

- Compulsory: (Total Credit Hours = 27 CrH/ 9 courses)
- Introduction to Artificial Intelligence
- Machine Learning
- Artificial Neural Network and Deep Learning
- Computer Vision
- Natural Language Processing (New)
- Introduction to Autonomous Robotics (New)
- Introduction to Data Mining (New)
- Embedded Systems
- High Performance Computing

- Elective: (Total Credit Hours = 9 CrH/ 3 courses)
- Fuzzy Logic
- Reinforcement Learning
- Game Development
- Introduction to IoT
- Advanced Embedded Systems

- Fundamental Courses to Support AIR
- Programming for Engineers
- Object Oriented Programming
- Data Structure and Algorithms

- Mathematical Foundation Of Computing
- Probability and Random Processes
- Linear Algebra I
- Numerical Techniques
- Digital Signal Processing

- Microprocessor 1
- Electric Circuits 1
- Electric Circuits and Machines
- Electronics I
- Operating Systems
- Control Systems
- Principles of Communication Systems
- Computer Networks

ANNEX 2b

Tafila Technical University
Faculty of Engineering
Department of Communication,
Electronics and Computer Engineering

جامعة الطفيلة التقنية
كلية الهندسة
دسة الاتصالات والالكترونيات
وهندسة الحاسوب

Study Plan
Intelligent Systems Engineering

الخطة الدراسية
هندسة الأنظمة الذكية

الخطة الدراسية لنيل درجة البكالوريوس
في تخصص هندسة الأنظمة الذكية
2021/2021
(161) ساعة معتمدة موزعة كالآتي

أولا: متطلبات الجامعة (27) ساعة معتمدة		
.1	متطلبات الجامعة الإجبارية	**21ساعة**
.2	متطلبات الجامعة الاختيارية	**6ساعة**
ثانياً: متطلبات الكلية (27) ساعة معتمدة		
.1	متطلبات الكلية الإجبارية	**27ساعة**
ثالثاً: متطلبات التخصص (106) ساعة معتمدة		
.1	متطلبات التخصص الإجبارية	**97ساعة**
.2	متطلبات التخصص الاختيارية	**9ساعة**
المجموع		**160 ساعة**

متطلبات الجامعة التي تقع خارج الخطة الدراسية:
أ. امتحانات الجامعة الإجبارية:

رقم المادة	اسم المادة	الساعات المعتمدة
0501098	امتحان مستوى اللغة العربية	0
0502098	امتحان مستوى اللغة الانجليزية	0
0206098	امتحان مستوى مهارات الحاسوب	0

ب. امتحانات الجامعة الإجبارية:

رقم المادة	اسم المادة	الساعات المعتمدة
0501099	اللغة العربية الاستدراكية	0
0502099	اللغة الانجليزية الاستدراكية	0
0206099	مهارات الحاسوب الاستدراكية	0

Tafila Technical University

Faculty of Engineering
Department of Communication, Electronics and Computer Engineering
Study Plan
Intelligent Systems Engineering

جامعة الطفيلة التقنية

كلية الهندسة
قسم هندسة الاتصالات والالكترونيات وهندسة الحاسوب
الخطة الدراسية
هندسة الأنظمة الذكية

Tafila Technical University		جامعة الطفيلة التقنية
Faculty: Engineering		كلية:الهندسة
Department: Communication and Electronics and Computer Engineering		قسم:هندسة الاتصالات والالكترونيات وهندسة الحاسوب
Study plan for Intelligent Systems Engineering major		الخطة الدراسية لتخصص:هندسة الأنظمة الذكية
Effective starting from the academic year 2021\2022		يبدأ تطبيق الخطة على الطلبة المقبولين للعام الجامعي: 2021/2021

First: University requirements — **أولاً: متطلبات الجامعة**

1- Mandatory: 12 credit hours — **1- الإجبارية: 12 ساعة معتمدة**

المتطلب السابق أو المتزامن Prerequisite or concurrent enrollment			الساعات			اسم المادة Course name		رقم المادة Course number
اسم المادة Course name		رقم المادة Course number	عملي Practical	نظري Theoretical	معتمدة credit	English	عربي	
English	عربي							
Arabic language placement test	امتحان مستوى اللغة العربية	0501098	-	3	3	Arabic language 1	اللغة العربية 1	0501101
English language placement test	امتحان مستوى اللغة الإنجليزية	0502098	-	3	3	English language 1	اللغة الإنجليزية 1	0502101
-	-	-	-	3	3	* Military science	العلوم العسكرية *	0503103
-	-	-	-	3	3	National education **	التربية الوطنية **	0503101

* Mandatory for Jordanian students and elective for foreign students, foreign students who didn't choose it should choose another course from the university elective courses.
** Mandatory for Jordanian students and elective for foreign students, foreign students who didn't choose it should choose another course from the university elective courses.

* مادة إجبارية للطلبة الأردنيين واختيارية لغير الأردنيين، وعلى الطلبة غير الأردنيين الذين لم يختاروا هذه المادة دراسة مادة أخرى من متطلبات الجامعة الاختيارية ولا تدخل علامتها في معدل الطالب بل تحسب له ناجحاً أو راسباً.
** مادة إجبارية للطلبة الأردنيين واختيارية لغير الأردنيين، وعلى الطلبة غير الأردنيين الذين لم يختاروا هذه المادة دراسة مادة أخرى من متطلبات الجامعة الاختيارية.

2- Elective: 15 credit hours, students should choose them from three different categories with at least three credit hours from each categories.

2- الاختيارية: 15 ساعات معتمدة، وتقسم إلى ثلاث مجالات, يدرس الطالب في الحد الأدنى ثلاث ساعات من كل مجموعة وست ساعات كحد أقصى من كل مجموعة وهي:

ملاحظات	المتطلب السابق أو المتزامن Prerequisite or concurrent enrollment		الساعات Hours			اسم المادة Course name		رقم المادة Course number
	English	عربي	عملي Practical	نظري Theoretical	معتمدة credit	English	عربي	
مجموعة التكنولوجيا والعلوم /تطرحها كلية الهندسة وكلية العلوم								
باستثناء طلبة كلية* الهندسة	-	-	-	3	3	Automobile Maintenance	صيانة السيارات	0101103
	-	-	-	3	3	Mineral Resources in Jordan	الثروات المعدنية في الأردن	0105103
				3	3	Introduction to Environmental Sciences	مقدمة في العلوم البيئية	0105101
باستثناء طلبة قسم الكيمياء	-	-	-	3	3	Chemistry in our Life	الكيمياء في حياتنا	0201103
باستثناء طلبة قسم الفيزياء	-	-	-	3	3	Physics and Society	الفيزياء والمجتمع	0202103
باستثناء طلبة تخصص نظم المعلومات الحاسوبية	-	-	-	3	3	Internet Skills	مهارات الإنترنت	0206103
مجموعة العلوم الاقتصادية والتربوية/ تطرحه كلية العلوم الإدارية وكلية العلوم التربوية								
باستثناء طلبة كلية العلوم التربوية	-	-	-	3	3	Basics of Education	أسس التربية	0302101
	-	-	-	3	3	Introduction to Psychology	مدخل إلى علم النفس	0301101
	-	-	-	3	3	Introduction to Environmental Education	مقدمة في التربية البيئية	0302111
	-	-	-	3	3	Study Skills Principles	أساسيات مهارات الدراسة	302112
	-	-	-	3	3	Principles of Thoughts	مبادئ التفكير	0301102
باستثناء طلبة كلية العلوم الإدارية	-	-	-	3	3	Basics of Administration	أساسيات الإدارة	0404103
	-	-	-	3	3	Basics of Economy	أساسيات الاقتصاد	0403104
	-	-	-	3	3	Introduction to Planning	مقدمة في التخطيط	0403105
	-	-	-	3	3	Job Ethics	أخلاقيات العمل	0402410

0301104	مهارات الحياة	Life Skills	3	3	-	-	-	والمالية
مجموعة العلوم الإنسانية /تطرحها كلية الآداب								
0503103	الثقافة الإسلامية	Islamic Culture	3	3	-	-	-	-
0503104	البيئة والمجتمع	Environment and Society	3	3	-	-	-	-
0503105	المجتمع الأردني	Society of Jordan	3	3	-	-	-	-
0503106	آثار الأردن	Antiquities of Jordan	3	3	-	-	-	-
0503107	مقدمة في الفنون الإسلامية	Introduction to Islamic Arts	3	3	-	-	-	-
0503108	حقوق الإنسان	Human Rights	3	3	-	-	-	-
0503109	حاضر العالم الإسلامي	Contemporary of Islamic World	3	3	-	-	-	-
0503110	مدخل إلى العنف الأسري	Introduction to Family Violence	3	3	-	-	-	-
0502102	اللغة الإنجليزية(2)	English Language (2)	3	3	-	اللغة الإنجليزية(1)	English Language (1)	باستثناء طلبة تخصص اللغة الانجليزية وآدابها
501102	اللغة العربية (2)	Arabic Language (2)	3	3	-	اللغة العربية (1)	Arabic Language (1)	باستثناء طلبة تخصص اللغة العربية وآدابها

ANNEX 2c

Tafila Technical University

Faculty of Engineering

Department of Communication, Electronics and Computer Engineering

Study Plan

Intelligent Systems Engineering, B.Sc.

2021/2022

Total Credit Hours (160 CrH)

- **University Requirements: 27 CrH**
- **College Requirements: 27 CrH**
- **Major Requirements: 106 CrH**
  1) **Major Compulsory: 97 CrH**
  2) **Major Elective: 9 CrH**

List of courses according to the "fields of knowledge" in accordance with the criteria of the national accreditation:

- **Math and Sciences**

Field	Course Title	Total CrH	Min CrH
Math	Calculus I	30	30
	Calculus II		
	Engineering Mathematics		
	Mathematical Foundation Of Computing (Discrete Math)		
	Linear Algebra		
	Probability and Random Processes		
	Numerical Techniques		
Sciences	Physics I		
	Physics II		
	Chemistry I		

- **Engineering Sciences Fundamentals**

Field	Course Title	Total CrH	Min CrH
Engineering Sciences Fundamentals	Programming for Engineers	15	12
	Engineering Workshops I		
	Engineering Drawing (AutoCAD)		
	Profession Ethics for Engineers		
	Engineering Economics		
	Communication Skills, Arabic		
	Communication Skills, English		

- **Electrical Engineering**

Field	Course Title	Total CrH	Min CrH
Electrical Engineering Fundamentals	Electric Circuits I	9	9
	Electronics I		
	Digital Logic Design		
Computer and Communication	Signals and Systems	6	6
	Principles of Communication Systems		
Control and Power	Control Systems	6	6
	Electric Circuits and Machines		

- **Intelligent Systems Engineering**

Field	Course Title	Total CrH	Min CrH
Artificial Intelligence and Machine Learning	Introduction to Artificial Intelligence	18	30
	Machine Learning		
	Artificial Neural Network and Deep Learning		
	Computer Vision		
	Natural Language Processing		
	Introduction to Data Mining		
Computer Programming and Software Systems	Object Oriented Programming	9	
	Data Structure and Algorithms		
	Operating Systems		
Microprocessors and Computing systems	Microprocessor 1	12	
	High Performance Computing		
	Embedded Systems		
	Introduction to Autonomous Robotics		

ANNEX 2

Proposed Master's Program in
AI and Robotics
The University of Jordan

Introduction

This proposed program is consistent with the local regulations summarized as follows:

- The program should typically be 33 credit hours (CH). Up to additional 9 CH can be approved in special cases. The organization of the program should conform with the following limits:
  - 15 – 24 CH for mandatory courses
  - 9 – 12 CH for elective courses
  - 9 CH for the thesis
- One mandatory course must be Research Methodology

Proposed Courses

The proposed program has 33 CH and consists of the following three components:

1. Five Mandatory Courses: 15 CH

Course No.	Course Name	CH	Pre-requisite
0907703	Research Methodology	3	-
0907743	Applied Artificial Intelligence and Machine Learning	3	-
0907726	Computer Vision	3	0907743
0908721	Introductory Robotics: Sensing, Controlling and Actuating	3	-
0907744	Data Science	3	0907743

2. Three Elective Courses from of the following table: 9 CH

Course No.	Course Name	CH	Pre-requisite
0907725	Internet of Things Applications	3	-
0907745	Advanced Big Data Analytics	3	0907743
0907752	Natural Languages Processing	3	0907743
0907754	Unsupervised Learning	3	0907743
0907759	Advanced Topics in Artificial Intelligence	3	0907743
0908722	Industrial and Applied Robotics	3	0908721
0908723	Autonomous Mobile Robots	3	0908721
0908724	Humanoid Robotic Systems	3	0908721
0908725	Advanced Control Theory	3	0908721
0908751	Advanced Topics in Robotics	3	0908721

3. Thesis: 9 CH

ANNEX 3

WP2 - Task 2.1

Genoa Virtual Meeting agenda

Virtual Meeting - Part 1

Fri 30 Apr 2021, time 9:15 am – 12:15 pm Amman time (8:15 am – 11:15 pm CEST) - 3 hours

Platform: Zoom

Meeting link: https://zoom.us/j/91918636653?pwd=Z2ozTUxHZ2sxb2ZxOXdrYndXOHdkdz09

- 09:15 am - DeCAIR WP2 overview (Francesco Masulli)
- 09:30 am - Needs of AI and robotics in JO identified in WP1 report (Iyad Jafar)
- 09:45 am - Organization of B.Sc. Programs in Jordan (Murad Alaqtash)
- 10:00 am – Questions
- 10:15 am - Proposed B.Sc. Program in Intelligent Systems Engineering at Tafila Technical University (Murad Alaqtash)
- 11:10 am - Questions and discussion. All partners, 5 min each in this order: UNIPI; UNIGE; UGR; UST; CRE.THI. DEV; LU; BAU; JUST; UJ; TTU
- 12:05 pm - Concluding remarks (Francesco Masulli)

Virtual Meeting – Part 2

Fri 7 May 2021, time 9:15 am – 12:15 pm Amman time (8:15 am – 11:15 pm CEST) - 3 hours

Platform: Zoom

Meeting link: https://zoom.us/j/93258384819?pwd=a2tualFVQnhid1FETHphdHFjY1FoUT09

- 09:15 am - Organization of M. Sc. Programs in Jordan (Ramzi Saifan)
- 09:30 am – Questions
- 09:45 am - Proposed Master's Program in AI and Robotics at the University of Jordan (Ramzi Saifan)
- 10:45 am - Questions and discussion. All partners, 5 min each in this order: UNIPI; UNIGE; UGR; UST; CRE.THI. DEV; LU; BAU; JUST; TTU; UJ
- 11:35 am - Composition and next meetings of the focus groups on AI and on Robotics (Francesco Masulli)
- 11:45 am - Overall discussion
- 12:05 am - Conclusions and recommendations (Francesco Masulli)

ANNEX 4

WP2 - Task 2.1
Proposed B. Sc. Program in AI and Robotics at the Tafila Technical University
Comments and Discussion

1. Comments and suggestions

1.1 The University of Jordan

The suggested list or courses and the course structure is generally excellent. We have some particular suggestions:

- As TTU is considering ABET accreditation, it is advised to review this list against ABET guidelines.
- The list of elective courses is too long (18 course). Consider shortening it to 9-12 courses.
- Some course prerequisites need review to ensure that every course has only the relevant and needed courses as its prerequisites. This review needs coordination with the other program offered by the department (BSc in Computer Engineering).
- It is suggested that the course Microprocessors 1is replaced by a Computer Organization course. Or add the Computer Organization course and merge Microprocessors 1 with Embedded Systems.
- A course in Statistics is needed. It could be combined with Probability.
- The two introductory courses in AI and ML can be merged in one course to give space for more robotics courses.
- The course Introduction to Autonomous Robots should be Introduction to Robotics.
- Since TTU is adding more robotics courses, a good idea is to join the Robotics Focus Group and the robotics training.

1.2 Jordan University of Science and Technology

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1.3 Lebanese University

Clovis Francis: we need to balance the program between AI and Robotics. Only one course related to Robotics is in the program. Possibility to merge 4 AI courses in 3.

Excellent program, may be one should enhance and look into a deeper list of contents

- Should be aware of the Big overlap between courses machine learning, AI, data mining, Computer vision and natural language processing.
- Unless it will appear somewhere, we didn’t see any material related to State Estimation Based on Dynamic models like for example Kalman filtering, particle filtering. Such methods

are very used in several common AI/Robotics applications and constitute useful tool gathering, prediction based on dynamic models, dynamic data fusion and state estimation.

- Must be aware of not directing lessons towards applications to the detriment of the mathematical notions necessary for any level training in the field of science and technology. For example, Statistics should appear in the programs. Several notions are useful in the two fields of AI and Robotics for example make a summary of a huge amount of data, parameters estimation, CI, statistics test for analyzing the results.
- Statistics/linear algebra / programming is the pre-requisite to data mining.

1.4 Beirut Arab University

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1.5 University of Pisa

UNIPI suggests to have an introductory class to robotics (kinematics, dynamics, control) and another course more advanced on AI applications to robotics (motion planning, guidance and navigation, vision systems)

1.6 University of Genoa

- Courses should be planned thinking about the follow-up: Profession or MSc.
- Remark: If the course is going to be launched in September 2021, bureaucracy must be very efficient.
- Regarding the plan, it may be advisable to add some explanation and rationale of the overall project besides the lists of subjects with credits.
- Some courses in fundamentals of mechanics, in control theory and in optimization should be present in the core, and this may mean removing some detailed subjects that can be taught later or as part of other, more general subjects.
- More generally, there is a high number of subjects: it is advisable to find a reasonable balance between variety of subjects and depth of each one. For a BSc, depth is to be preferred over variety.
- Considering that the partner universities are from the European area, it might be useful as a working convention to convert the evaluation from CH (credit hours) to the ECTS system, which is more comprehensive since it accounts for the personal work in addition to work in presence, and allows direct comparison with courses across Europe. Of course, without losing track of the university and ministry requirements.
- File TTU2 -Tafila Technical University - Intelligent Systems Engineering Study Plan_17-4-2021 contains two different notes with different symbols but the same text.

1.7 University of Granada

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1.8 University of Stuttgart

In general, although the main emphasis is on AI, it may makes sense to include one or more additional robotics course(s). Especially, having one basic course in robotics, i.e., dealing with modeling, kinematic, and dynamics, can be valuable for students to develop a deep

understanding. Moreover, depending on the staff and equipment available, a practical example could be included in one of the robotics courses.

Furthermore, it might be an option for further programs, to start by discussing which contents the program should cover. Based on this, the corresponding courses could be developed.

1.9 Creative Thinking Development

- It is recommended to introduce a new course ' Legal and Ethical issues of AI and Robotics' which is something that most Universities are accepting in their curricula
- In order to have a balance between Robotics and AI it is proposed to add 2 more courses
    - Robotics Programming (core course) – and possibly merging with embedded systems
    - Applied Robotics Kinematics Dynamics and Control (optional)
- Assuming that Machine learning course exploits all 3 types (supervised, unsupervised and reinforced) it is proposed to merge the 2 courses (Game development and reinforcing learning in one)
- It is recommended the course - Introduction to Autonomous Robotics to be rescheduled as Introduction to Cyber Physical Systems and Autonomous Robotics when in first part of the course you will introduce to CFS including autonomy and intelligence.

2. Discussion by the Tafila Technical University

Partners' comments and suggestions were valuable and enrich the proposed Intelligent Systems Engineering B.Sc. program definitely. Most of the suggestions have been considered in the updated version of ISE plan proposal. Others regarding the contents of courses will be considered in the next activities as we start to design the course syllabi. Listed below are the changes made to reflect the comments and suggestions.

The University of Jordan:

- The list of elective courses is shortened to 11 courses
- Courses prerequisites are reviewed to maintain only relevant prerequisites
- The description of microprocessors 1 course will be modified to embrace the essential knowledge for ISE, as well as to maintain the fundamental concepts required for Computer Engineering program.
- Statistics is added to "Statistical Analysis and Data Mining" course.
- "Introduction to Artificial Intelligence and Machine Learning" course merges both AI and ML
- Two courses on robotics are introduced, "Introduction to Robotics" and "Applications of AI in Robotics"
- Since TTU is working towards ABET accreditation for its bachelor programs, TTU administration is informed to consider the ISE program as one of target programs for ABET. A team from the college of engineering and accreditation and quality assurance center will review the guidelines of ABET to be considered.

Lebanese University:

- Two courses on robotics are introduced, "Introduction to Robotics" and "Applications of AI in Robotics"

- “Introduction to Artificial Intelligence and Machine Learning” course merges both AI and ML
- The contents of proposed courses will be designed carefully to focus on the relevant concepts and its applications as well as avoid any overlap among courses.
- Dynamic modeling will be briefed in the introduced course “Introduction to Robotics”
- Statistics is added to “Statistical Analysis and Data Mining” course.
- Courses prerequisites are reviewed

University of Pisa:

- Two courses on robotics are introduced, “Introduction to Robotics” and “Applications of AI in Robotics”

University of Genoa:

- The contents of proposed courses will be designed carefully to present the essential and relevant topics as well as provide the hands on experience on the applications of AIR
- A course of 3 CH (credit hours) in Jordan is equivalent to 5-6 ECTS.

University of Stuttgart:

- Two courses on robotics are introduced, “Introduction to Robotics” and “Applications of AI in Robotics”. Kinematic, dynamics, and modeling will be briefed in the first course.

Creative Thinking Development:

- Legal and Ethical issues is covered in a more general course called “Profession Ethics for Engineers” listed in college requirements. More specific topics related to AIR may be added to the major courses deals with applications of AIR.
- Two courses on robotics are introduced, “Introduction to Robotics” and “Applications of AI in Robotics”. Kinematic, dynamics, and modeling will be briefed in the first course.
- “Reinforcement Learning and Game Development” course is introduced.

ANNEX 5

WP2 - Task 2.1
Proposed M. Sc. Program in AI and Robotics at the University of Jordan
Comments and Discussion

1. Comments and suggestions

1.1 Jordan University of Science and Technology

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1.2 Tafila Technical University

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1.3 Lebanese University

- Why the course number 8 should be only on unsupervised learning? (This remark was pointed out also by a colleague from Tafila University I think). It's well-known that unsupervised learning is an important task for Robotics applications, but first, to devote a course to this notion seems to overestimate its content, and second, it will be to the detriment of other important notions such as Supervised and reinforcement learning as pointed out by the colleague of Tafila University.
- Can we suggest a minimum requirement of CRH in robotics and AI for elective courses, because if a student choose 9 CRH form the AI courses, in this case the program becomes unbalanced for this student with very few knowledge under the robotics title? Or add robotics related courses to the mandatory course.
- Same remark we have done to the Bachelor formation of Tafila University, Unless it will appear somewhere In a special course, we didn't see any material related to State Estimation Based on Dynamic models like for example Kalman filtering, particle filtering. Such methods are very used in several common AI/Robotics applications and constitute useful tool gathering, prediction based on dynamic models, dynamic data fusion and state estimation.

1.4 Beirut Arab University

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1.5 University of Pisa

The organization of the Robotics courses at University of Jordan is excellent and covers several aspects of robotics from more basic topics as modeling and control to more advanced and attractive topics as industrial, humanoid and mobile robotics.

UNIPI does not have particular comments on the organization but more comments will be provided for the contents of the courses. A minor comment regards the possibility of including AI application to Robotics in the “Advanced Topics in Robotics”.

1.6 University of Genoa

- The written project needs more rationale, as of now it is a list of courses but the teaching project behind it is not explained.
- A course in data science may be too broad in scope; this may be the subject of a whole MSc program. Data analytics (proposed as an elective course) is part of data science. Either “Data science” is an introductory course (“Introduction to data science”) or it should be more focused, on more specific topics
- On the other hand, unsupervised learning may not deserve a whole course since it is a very specific topic; one idea might be to make it cover other alternative learning methods as well, like reinforcement learning.
- Some additional elective courses could cover prerequisites that some students don’t possess, like optimisation, statistics, mechanics, control theory, depending on their previous studies. Students coming from different backgrounds can cover their requirements by including these courses; these may become “mandatory electives”. This would widen the audience and increase the appeal of the program.
- It is advisable to plan the possible career paths from BSc to MSc at the semester level by some simulations, to check if people with a given background can end their master having a coverage of all needed subjects, in the correct order.

1.7 University of Granada

—

1.8 University of Stuttgart

- Why the course number 8 should be only on unsupervised learning? (This remark was pointed out also by a colleague from Tafila University I think). It’s well-known that unsupervised learning is an important task for Robotics applications, but first, to devote a course to this notion seems to overestimate its content, and second, it will be to the detriment of other important notions such as Supervised and reinforcement learning as pointed out by the colleague of Tafila University.
- Can we suggest a minimum requirement of CRH in robotics and AI for elective courses, because if a student choose 9 CRH form the AI courses, in this case the program becomes unbalanced for this student with very few knowledge under the robotics title? Or add robotics related courses to the mandatory courses…
- Same remark we have done to the Bachelor formation of Tafila University, Unless it will appear somewhere In a special course, we didn’t see any material related to State Estimation Based on Dynamic models like for example Kalman filtering, particle filtering. Such methods are very used in several common AI/Robotics applications and constitute useful tool gathering, prediction based on dynamic models, dynamic data fusion and state estimation.

1.9 Creative Thinking Development

Some minor comments:

- Data science should be prerequisite for Applied Artificial Intelligence and Machine Learning and not the opposite
- Applied Artificial Intelligence and Machine Learning has to be assigned in more credits and possibly to be split in 2 courses
- Computer Vision should be to electives and possibly Internet of Things Applications to be in core courses
- It is recommend to be an optional course on Security and another on legal and ethical issues of AI and ML

2. Discussion by The University of Jordan

We would like first to thank our partners for their valuable comments. Please note that we tried to address their comments and suggestions as much as possible. The following is a list of modifications we made:

1) We prepared an advisory plan which draws a road map for the students. The plan shows which courses can be registered each semester. It was also designed for students who are willing to register 2 courses per semester and for students who wants to register 3 courses per semester.
2) We added a course “Reinforcement Learning” to the elective courses due to its importance in the robotics field. However, we kept “Unsupervised learning” course due to its importance.
3) We determined the set of courses that we expect any student who joins the master program in AIR should know in advance. If the student did not study these courses in the bachelor, then he/she should take these courses from the bachelor level.
4) We decided to add the ethics topics to the research methodology course.
5) We removed the course “Humanoid Robotic Systems” from the curriculum.
6) Some suggested topics like “Evolutionary Algorithms”, “AI Application to Robotics” and others can be offered under either “Advanced topics in AI” or “Advanced Topics in Robotics”.

ANNEX 6a

Intelligent Systems Engineering, B.Sc.

- **Compulsory: (Total Credit Hours = 27 CrH/ 9 courses)**
  - Introduction to Artificial Intelligence and Machine Learning
  - Artificial Neural Network and Deep Learning
  - Computer Vision
  - Natural Language Processing
  - Introduction to Robotics
  - Applications of AI in Robotics
  - Embedded Systems
  - High Performance Computing
  - Statistical Analysis And Data Mining

- **Elective: (Total Credit Hours = 9 CrH/ 3 courses)**
  - Emerging Technology in Artificial Intelligence
  - Fuzzy Logic
  - Introduction to IoT
  - Reinforcement Learning and Game Development
  - Cyber Physical System
  - Advanced Embedded Systems
  - Database Systems
  - Software Engineering
  - Modeling and Simulation
  - Cloud computing
  - Computer and Network Security

- **Fundamental Courses to Support AIR**
  - Programming for Engineers
  - Object Oriented Programming
  - Data Structure and Algorithms

  - Mathematical Foundation Of Computing
  - Probability and Random Processes
  - Linear Algebra I
  - Numerical Techniques
  - Digital Signal Processing

  - Microprocessor 1
  - Electric Circuits 1
  - Electric Circuits and Machines
  - Electronics I

  - Operating Systems
  - Control Systems

- Principles of Communication Systems
- Computer Networks

ANNEX 6b

Tafila Technical University
Faculty of Engineering
Department of Communication,
Electronics and Computer Engineering

جامعة الطفيلة التقنية
كلية الهندسة
هندسة الاتصالات والالكترونيات
وهندسة الحاسوب

Study Plan
Intelligent Systems Engineering

الخطة الدراسية
هندسة الأنظمة الذكية

الخطة الدراسية لنيل درجة البكالوريوس
في تخصص هندسة الأنظمة الذكية
2021/2021
(160) ساعة معتمدة موزعة كالآتي

أولا: متطلبات الجامعة (27) ساعة معتمدة		
.1	متطلبات الجامعة الإجبارية	**21ساعة**
.2	متطلبات الجامعة الاختيارية	**6ساعة**
ثانياً: متطلبات الكلية (27) ساعة معتمدة		
.1	متطلبات الكلية الإجبارية	**27ساعة**
ثالثاً: متطلبات التخصص (106) ساعة معتمدة		
.1	متطلبات التخصص الإجبارية	**97ساعة**
.2	متطلبات التخصص الاختيارية	**9ساعة**
المجموع		**160 ساعة**

متطلبات الجامعة التي تقع خارج الخطة الدراسية:

أ. امتحانات الجامعة الإجبارية:

رقم المادة	اسم المادة	الساعات المعتمدة
0501098	امتحان مستوى اللغة العربية	0
0502098	امتحان مستوى اللغة الانجليزية	0
0206098	امتحان مستوى مهارات الحاسوب	0

ب. امتحانات الجامعة الإجبارية:

رقم المادة	اسم المادة	الساعات المعتمدة
0501099	اللغة العربية الاستدراكية	0
0502099	اللغة الانجليزية الاستدراكية	0
0206099	مهارات الحاسوب الاستدراكية	0

Tafila Technical University

Faculty of Engineering
Department of Communication, Electronics and Computer Engineering
Study Plan
Intelligent Systems Engineering

جامعة الطفيلة التقنية

كلية الهندسة
قسم هندسة الاتصالات والالكترونيات وهندسة الحاسوب
الخطة الدراسية
هندسة الأنظمة الذكية

Tafila Technical University		جامعة الطفيلة التقنية
Faculty: Engineering		كلية:الهندسة
Department: Communication and Electronics and Computer Engineering		قسم:هندسة الاتصالات والالكترونيات وهندسة الحاسوب
Study plan for Intelligent Systems Engineering major		الخطة الدراسية لتخصص:هندسة الأنظمة الذكية
Effective starting from the academic year 2021\2022		يبدأ تطبيق الخطة على الطلبة المقبولين للعام الجامعي: 2021/2021

First: University requirements — **أولاً: متطلبات الجامعة**

1- Mandatory: 21 credit hours — **1- الإجبارية: 21 ساعة معتمدة**

المتطلب السابق أو المتزامن Prerequisite or concurrent enrollment			الساعات			اسم المادة Course name		رقم المادة Course number
اسم المادة Course name		رقم المادة Course number	عملي Practical	نظري Theoretical	معتمدة credit	English	عربي	
English	عربي							
Arabic language placement test	امتحان مستوى اللغة العربية	0501098	-	3	3	Arabic language 1	اللغة العربية 1	0501101
English language placement test	امتحان مستوى اللغة الإنجليزية	0502098	-	3	3	English language 1	اللغة الإنجليزية 1	0502101
-	-	-	-	3	3	* Military science	العلوم العسكرية *	0503103
-	-	-	-	3	3	National education **	التربية الوطنية **	0503101

* Mandatory for Jordanian students and elective for foreign students, foreign students who didn't choose it should choose another course from the university elective courses.
** Mandatory for Jordanian students and elective for foreign students, foreign students who didn't choose it should choose another course from the university elective courses.

* مادة إجبارية للطلبة الأردنيين واختيارية لغير الأردنيين، وعلى الطلبة غير الأردنيين الذين لم يختاروا هذه المادة دراسة مادة أخرى من متطلبات الجامعة الاختيارية ولا تدخل علامتها في معدل الطالب بل تحسب له ناجحاً أو راسباً.
** مادة إجبارية للطلبة الأردنيين واختيارية لغير الأردنيين، وعلى الطلبة غير الأردنيين الذين لم يختاروا هذه المادة دراسة مادة أخرى من متطلبات الجامعة الاختيارية.

2- Elective: 6 credit hours, students should choose them from three different categories with at least three credit hours from each categories.

2- الاختيارية: 6 ساعات معتمدة، وتقسم إلى ثلاث مجالات, يدرس الطالب في الحد الأدنى ثلاث ساعات من كل مجموعة وست ساعات كحد أقصى من كل مجموعة وهي:

ملاحظات	المتطلب السابق أو المتزامن Prerequisite or concurrent enrollment		الساعات Hours			اسم المادة Course name		رقم المادة Course number
	English	عربي	عملي Practical	نظري Theoretical	معتمدة credit	English	عربي	
مجموعة التكنولوجيا والعلوم /تطرحها كلية الهندسة وكلية العلوم								
باستثناء طلبة كلية* الهندسة	-	-	-	3	3	Automobile Maintenance	صيانة السيارات	0101103
	-	-	-	3	3	Mineral Resources in Jordan	الثروات المعدنية في الأردن	0105103
				3	3	Introduction to Environmental Sciences	مقدمة في العلوم البيئية	0105101
باستثناء طلبة قسم الكيمياء	-	-	-	3	3	Chemistry in our Life	الكيمياء في حياتنا	0201103
باستثناء طلبة قسم الفيزياء	-	-	-	3	3	Physics and Society	الفيزياء والمجتمع	0202103
باستثناء طلبة تخصص نظم المعلومات الحاسوبية	-	-	-	3	3	Internet Skills	مهارات الإنترنت	0206103
مجموعة العلوم الاقتصادية والتربوية/ تطرحه كلية العلوم الإدارية وكلية العلوم التربوية								
باستثناء طلبة كلية العلوم التربوية	-	-	-	3	3	Basics of Education	أسس التربية	0302101
	-	-	-	3	3	Introduction to Psychology	مدخل إلى علم النفس	0301101
	-	-	-	3	3	Introduction to Environmental Education	مقدمة في التربية البيئية	0302111
	-	-	-	3	3	Study Skills Principles	أساسيات مهارات الدراسة	302112
	-	-	-	3	3	Principles of Thoughts	مبادئ التفكير	0301102
باستثناء طلبة كلية العلوم الإدارية	-	-	-	3	3	Basics of Administration	أساسيات الإدارة	0404103
	-	-	-	3	3	Basics of Economy	أساسيات الاقتصاد	0403104
	-	-	-	3	3	Introduction to Planning	مقدمة في التخطيط	0403105
	-	-	-	3	3	Job Ethics	أخلاقيات العمل	0402410

0301104	مهارات الحياة	Life Skills	3	3	-	-	-	والمالية
مجموعة العلوم الإنسانية /تطرحها كلية الآداب								
0503103	الثقافة الإسلامية	Islamic Culture	3	3	-	-	-	-
0503104	البيئة والمجتمع	Environment and Society	3	3	-	-	-	-
0503105	المجتمع الأردني	Society of Jordan	3	3	-	-	-	-
0503106	آثار الأردن	Antiquities of Jordan	3	3	-	-	-	-
0503107	مقدمة في الفنون الإسلامية	Introduction to Islamic Arts	3	3	-	-	-	-
0503108	حقوق الإنسان	Human Rights	3	3	-	-	-	-
0503109	حاضر العالم الإسلامي	Contemporary of Islamic World	3	3	-	-	-	-
0503110	مدخل إلى العنف الأسري	Introduction to Family Violence	3	3	-	-	-	-
0502102	اللغة الإنجليزية(2)	English Language (2)	3	3	-	اللغة الإنجليزية(1)	English Language (1)	باستثناء طلبة تخصص اللغة الانجليزية وادابها
501102	اللغة العربية (2)	Arabic Language (2)	3	3	-	اللغة العربية (1)	Arabic Language (1)	باستثناء طلبة تخصص اللغة العربية وادابها

ANNEX 6c

Tafila Technical University
Faculty of Engineering
Department of Communication, Electronics and Computer Engineering

Study Plan
Intelligent Systems Engineering, B.Sc.
2021/2022
Total Credit Hours (160 CrH)

- **University Requirements: 27 CrH**
- **College Requirements: 27 CrH**
- **Major Requirements: 106 CrH**
  - **Major Compulsory: 97 CrH**
  - **Major Elective: 9 CrH**

List of courses according to the “fields of knowledge” in accordance with the criteria of the national accreditation:

- **Math and Sciences**

Field	Course Title	Total CrH	Min CrH
Math	Calculus I	30	30
	Calculus II		
	Engineering Mathematics		
	Mathematical Foundation Of Computing (Discrete Math)		
	Linear Algebra		
	Probability and Random Processes		
	Numerical Techniques		
Sciences	Physics I		
	Physics II		
	Chemistry I		

- **Engineering Sciences Fundamentals**

Field	Course Title	Total CrH	Min CrH
Engineering Sciences Fundamentals	Programming for Engineers	15	12
	Engineering Workshops I		
	Engineering Drawing (AutoCAD)		
	Profession Ethics for Engineers		
	Engineering Economics		
	Communication Skills, Arabic		
	Communication Skills, English		

- **Electrical Engineering**

Field	Course Title	Total CrH	Min CrH
Electrical Engineering Fundamentals	Electric Circuits I	9	9
	Electronics I		
	Digital Logic Design		
Computer and Communication	Signals and Systems	6	6
	Principles of Communication Systems		
Control and Power	Control Systems	6	6
	Electric Circuits and Machines		

- **Intelligent Systems Engineering**

Field	Course Title	Total CrH	Min CrH
Artificial Intelligence and Machine Learning	Introduction to Artificial Intelligence and Machine Learning	21	30
	Artificial Neural Network and Deep Learning		
	Computer Vision		
	Natural Language Processing		
	Introduction to Robotics		
	Applications of AI in Robotics		
	Statistical Analysis And Data Mining		
Computer Programming and Software Systems	Object Oriented Programming	9	
	Data Structure and Algorithms		
	Operating Systems		
Microprocessors and Computing systems	Microprocessor 1	9	
	High Performance Computing		
	Embedded Systems		

ANNEX 7

Proposed Master's Program in AI and Robotics The University of Jordan

Introduction

This proposed program focuses on the practical aspects and hands-on experience of using Artificial Intelligence (AI) and Robotics techniques to solve practical problems and develop efficient and competitive solutions. This program is consistent with the local regulations summarized as follows:

- The program should typically be 33 credit hours (CH). Up to additional 9 CH can be approved in special cases. The organization of the program should conform with the following limits:
  - 15 – 24 CH for mandatory courses
  - 9 – 12 CH for elective courses
  - 9 CH for the thesis
- One mandatory course must be Research Methodology

General Rules and Conditions

The general rules and conditions of this program are as follows.

1. Specialties of Admission

- BSc. in any of the Electrical Engineering specializations (Computer Engineering, Mechatronics Engineering, Electrical Engineering, Biomedical Engineering, Communications Engineering, etc.)
- BSc. in Mechanical Engineering
- BSc. in Industrial Engineering

2. Program Prerequisites

- Programming
- Digital Logic
- Embedded Systems
- Electronic and Electrical Circuits
- Math: Calculus, Statistics, Linear Algebra, Probability (Students who have gaps in these topics will be advised to cover them at the beginning of the relevant program courses)

3. Example Prerequisite Courses

- Computer Skills for Engineers (0907101)
- Digital Logic (0907231)
- Embedded Systems (0907333)
- Electrical Engineering (0903203)

Proposed Courses

The proposed program has 33 CH and consists of the following three components:

1. Five Mandatory Courses: 15 CH

Course No.	Course Name	CH	Pre-requisite
0907703	Research Methodology	3	-
0907743	Applied Artificial Intelligence and Machine Learning	3	-
0907752	Computer Vision	3	0907743
0908721	Introductory Robotics: Sensing, Controlling and Actuating	3	-
0907761	Applied Data Science	3	0907743

2. Three Elective Courses from of the following table: 9 CH

Course No.	Course Name	CH	Pre-requisite
0907725	Internet of Things Applications	3	-
0907753	Natural Languages Processing	3	0907743
0907754	Unsupervised Learning	3	0907743
0907755	Reinforcement Learning	3	0907743
0907759	Advanced Topics in Artificial Intelligence	3	0907743
0908722	Industrial and Applied Robotics	3	0908721
0908723	Autonomous Mobile Robots	3	0907743 & 0908721
0908725	Advanced Control Theory	3	0908721
0908751	Advanced Topics in Robotics	3	0908721
0907762	Advanced Big Data Analytics	3	0907761

3. Thesis: 9 CH

Suggested Study Plans

The student can finish this program in 4 full semesters when taking 9 CH per semester. However, if the student takes only 6 CH per semester, the program will be finished in 6 semesters. Appendix A gives advisory plans for the following four scenarios:

1) 9 CH per semester for students accepted on the first semester,
2) 6 CH per semester for students accepted on the first semester,
3) 9 CH per semester for students accepted on the second semester, and
4) 6 CH per semester for students accepted on the second semester.

These scenarios assume the following course offerings schedule:

- Each of the five mandatory courses is offered once per year.
- One to two elective courses are offered each semester.
- If students are admitted in the program in both semesters, then the mandatory courses "Applied Artificial Intelligence and Machine Learning" and “Introductory Robotics: Sensing, Controlling and Actuating” must each be offered twice a year.

Appendix A: Study Plan Scenarios

A.1. Nine credit hours per semester for students accepted on the first semester

First Year

First Semester			Second Semester		
	Course Title	**CH**		**Course Title**	**CH**
	Research Methodology	3		Applied Data Science	3
	Applied Artificial Intelligence and Machine Learning	3	*	Elective Course	3
	Introductory Robotics: Sensing, Controlling and Actuating	3	*	Elective Course	3
Total		**9**	**Total**		**9**

Second Year

First Semester			Second Semester		
	Course Title	**CH**		**Course Title**	**CH**
	Computer Vision	3	**	Thesis	6
*	Elective Course	3			
**	Thesis	3			
Total		**9**	**Total**		**6**

* The student may choose an elective course according to the preferred track as follows:

a. **AI track elective courses**: Natural Languages Processing, Unsupervised learning, Reinforcement Learning, and Advanced Topics in Artificial Intelligence
b. **Robotics track elective courses**: Advanced Control Theory, Industrial and Applied Robotics, Autonomous Mobile Robots, and Advanced Topics in Robotics.
c. **Other elective courses**: Advanced Big data analytics and Internet of Things Applications

Deployment of elective course is dependent on the availability of the instructor and the preferences of the students.

** Thesis is a nine credit hours. In the first semester, the student submits a proposal, and the thesis may be discussed in the next semester.

A.2. Six credit hours per semester for students accepted on the first semester

First Year

First Semester			Second Semester		
	Course Title	**CH**		**Course Title**	**CH**
	Applied Artificial Intelligence and Machine Learning	3		Applied Data Science	3
	Introductory Robotics: Sensing, Controlling and Actuating	3	*	Elective Course	3
Total		**6**	**Total**		**6**

Second Year

First Semester			Second Semester		
	Course Title	**CH**		**Course Title**	**CH**
	Research Methodology	3	*	Elective Course	3
	Computer Vision	3	**	Thesis	3
Total		**6**	**Total**		**6**

Third Year

First Semester			Second Semester		
	Course Title	**CH**		**Course Title**	**CH**
*	Elective Course	3	**	Thesis	3
**	Thesis	3			
Total		**6**	**Total**		**3**

A.3. Nine credit hours per semester for students accepted on the second semester

First Year

First Semester			Second Semester		
	Course Title	**CH**		**Course Title**	**CH**
				Applied Artificial Intelligence and Machine Learning	3
				Introductory Robotics: Sensing, Controlling and Actuating	3
			Total		**6**

Second Year

First Semester			Second Semester		
	Course Title	**CH**		**Course Title**	**CH**

	Research Methodology	3		Applied Data Science	3
	Computer Vision	3	*	Elective Course	3
*	Elective Course	3	**	Thesis	3
Total		**9**	**Total**		**9**

Third Year

First Semester		
	Course Title	**CH**
*	Elective Course	3
**	Thesis	3
**	Thesis	3
Total		**9**

$ The only elective course can be taken is Internet of Things Applications because it has no pre-requisites.

A.4. Six credit hours per semester for students accepted on the second semester

First Year

First Semester			**Second Semester**		
	Course Title	**CH**		**Course Title**	**CH**
				Applied Artificial Intelligence and Machine Learning	3
				Introductory Robotics: Sensing, Controlling and Actuating	3
			Total		**6**

Second Year

First Semester			**Second Semester**		
	Course Title	**CH**		**Course Title**	**CH**
	Research Methodology	3		Applied Data Science	3
	Computer Vision	3	*	Elective Course	3
Total		**6**	**Total**		**6**

Third Year

First Semester			**Second Semester**		
	Course Title	**CH**		**Course Title**	**CH**
*	Elective Course	3	*	Elective Course	3
**	Thesis	3	**	Thesis	3
Total		**6**	**Total**		**6**

Fourth Year

First Semester			Second Semester		
	Course Title	**CH**		**Course Title**	**CH**
**	Thesis	3			
Total		**3**			

ANNEX 8

DeCAIR Focus group on AI

		Teaching staff	email	Student	email
P1	UJ	Gheith Abandah	abandah@ju.edu.jo	Abrar Khaled	abrarkhaled10@gmail.com
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P6	UNIPI	----------	----------	----------	----------
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		Alberto Fernández	alberto@decsai.ugr.es		
		Siham Tabik	siham.tabik@gmail.com		
P9	UST	----------	----------	----------	---------

ANNEX 9

DeCAIR Focus group on Robotics

		Teaching staff	email	Student	email
P1	UJ	Musa Alyaman (FG leader for task 2.2)	m.alyaman@ju.edu.jo	Mohammadd Al-Fetyani	mohammad@al-fetyani.com
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		Mohammad Almashagbeh	m.mashagbeh@ju.edu.jo		
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