1	**Course title**	**Internet of Things**
2	**Course number**	**0917521**
3	**Credit hours (theory, practical)**	3,0
	Contact hours (theory, practical)	3,0
4	**Prerequisites/corequisites**	0907322 (Computer Networks) & 0907333 (Embedded Systems)
5	**Program title**	Computer Engineering
6	**Program code**	0907
7	**Awarding institution**	The University of Jordan
8	**School**	Engineering
9	**Department**	Computer Engineering
10	**Level of course**	Fifth year
11	**Year of study and semester (s)**	Fifth Year, First or Second Semester
12	**Final Qualification**	Passing the exams and delivering a project
13	**Other department (s) involved in teaching the course**	None
14	**Language of Instruction**	English
15	**Teaching methodology**	☒Regular (Physical) ☐Blended ☐Online
16	**Electronic platform(s)**	☐Moodle ☒Microsoft Teams ☐Skype ☐Zoom ☐Others……
17-A	**Course Time**	• **Section 1: 11:00 am -12:15 pm (Monday and Wednesday).**
17-B	**Date of production/revision**	September 2022

18. Course Coordinator:

Instructor: Prof. Khalid A. Darabkh
Office#: CPE 342,
Office hours: Monday, Tuesday, and Thursday: 12:30 pm - 1:30 pm, or by appointment
E-mail address: k.darabkeh@ju.edu.jo

19. Other instructors:

None

20. Course Description:

The Internet of Things (IoT) stands to be the next revolution in computing. Billions of data-spouting devices connected to the Internet are already fundamentally changing the way we live and work. This course teaches a deep understanding of IoT layers, protocols, packets, services, performance parameters of a packet network as well as applications such as web, peer-to-peer, sensor networks, and multimedia, transport services, mobile networking which includes roaming and handoffs, mobile IP, and infrastructure-less networks, IoT definitions which include overview, applications, potential & challenges, and architecture, IoT examples such as case studies, e.g. sensor body-area-network and control of a smart home. Students will learn IoT device programming (Arduino and Raspberry Pi), sensing and actuating technologies, and IoT protocol stacks (Zigbee, 5G, NFC, MQTT, etc).

21. Course aims and outcomes:

A- Aims:

- Getting a deep understanding of IoT stack and technologies from the ground up.
- Getting a deep understanding of the key enabling technology (infrastructure) of IoT, namely, wireless sensor networks.
- Getting familiar of constructing some of IoT applications.
- Incorporating the concept of computational intelligence into the clustering/routing of IoT domains.
- Getting a deep understanding of the Routing Protocol for Low Power and Lossy Networks over Internet of Things (RPL-IoT).
- Getting familiar of IoT device programming (Arduino and Raspberry Pi), sensing and actuating technologies, and IoT protocol stacks (Zigbee, 5G, NFC, MQTT, etc).

B- Intended Learning Outcomes (ILOs): Upon successful completion of this course students will be able to

I. Master the IoT stack and technologies from the ground up, [1]
II. Understand the key enabling technology (infrastructure) of IoT, namely, wireless sensor networks, [1, 3]
III. Understand the construction of some of IoT applications, [3]
IV. Incorporate the concept of computational intelligence into the clustering/routing of IoT domains, [3]
V. Master the Routing Protocol for Low Power and Lossy Networks over Internet of Things (RPL-IoT) [1]
VI. Master the IoT device programming, [3]
VII. Be familiar with contemporary issues in IoT technologies, [7]

22. Topic Outline and Schedule:

Topic	Week	Instructor	Teaching Methods*/platform	Evaluation Methods	Reference
IoT Architectures, Protocols, and Applications	1	Khalid A. Darabkh	Regular/Physical	Exams	[1]
IoT Recent Advances, Future Directions, and Recommendations	3	Khalid A. Darabkh	Regular/Physical	Exams	[7]
IoT Sensor Networks	4	Khalid A. Darabkh	Regular/Physical	Exams	[1, 3]
Construction of IoT Applications	7	Khalid A. Darabkh	Regular/Physical	Exams	[3]
Computational Intelligence and IoT Clustering/Routing	10	Khalid A. Darabkh	Regular/Physical	Exams	[3]
RPL-IoT: Deep dive, Recent Advances, Recommendations, and Future Directions	12	Khalid A. Darabkh	Regular/Physical	Exams	[1,7]
Computational Intelligence and RPL-IoT	13	Khalid A. Darabkh	Regular/Physical	Exams	[3]
IoT Device Programming	15	Khalid A. Darabkh	Regular/Physical	Exams	[3]

23. Teaching Methods and Assignments:

Development of ILOs is promoted through the following teaching and learning methods:

- The student attends the class presentations and participates in the discussions.
- The student studies online video recordings along with references and research papers.

24. Evaluation Methods and Course Requirements:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

- Quizzes and Exams
- Project Proposal and Final Report

25. Course Policies:

A. Attendance policies:

- Attendance is mandatory and highly encouraged. To that end, attendance will be taken every lecture. All exams (including the final exam) should be considered cumulative.

B- Absences from exams and handing in assignments on time:

- A makeup exam can be arranged for students with acceptable absence causes.

C- Health and safety procedures:

- All health and safety procedure of the university and school should be followed.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

- The homeworks and exams are expected to be individual work (have to be done by your own) and completed without any help of your classmates. Handing in work that was jointly prepared and/or copied will be considered plagiarism and will be handled according to the University regulations.

E- Grading policy:

- Mid-term Exam (35%)
- Quizzes (5%)
- Project (10%)
- Final Exam (50%)

F- Available university services that support achievement in the course:

- Course Website: http://eacademic.ju.edu.jo/k.darabkeh/Material
- **Documents will be posted over Microsoft Teams**

26. Required equipment: (Facilities, Tools, Labs, Training….)

None

27. References:

The following research papers will be so valuable and helpful to understand the material covered in class:

[1] Wafa'a Kassab and Khalid A. Darabkh, "A-Z Survey of Internet of Things: Architectures, Protocols, Applications, Recent Advances, Future Directions and Recommendations," *Journal of Network and Computer Applications* (WoS/JCR, 2020 IF = 6.281), Elsevier, vol. 163, p.102663, August 2020.

[2] Khalid A. Darabkh, Wafa'a K. Kassab, and Ala' F. Khalifeh, "LiM-AHP-G-C: Life Time Maximizing Based on Analytical Hierarchal Process and Genetic Clustering Protocol for the Internet of Things Environment," *Computer Networks* (WoS/JCR, 2020 IF = 4.474), Elsevier, vol.176, p. 107253, July 2020.

[3] Khalid A. Darabkh, Asma'a B. Amareen, Muna Al-Akhras, and Wafa'a K. Kassab, "An Innovative Cluster-based Power-aware Protocol for Internet of Things Sensors Utilizing Mobile Sink and Particle Swarm Optimization," to appear in *Neural Computing and Applications*, (WoS/JCR, 2022 IF = 5.102), Springer, vol. 35, pp. 19365–19408, 2023.

[4] Khalid A. Darabkh, Muna Al-Akhras, Mohammed Atiquzzaman, and Jumana Zomot, "Routing Protocol for Low Power and Lossy Networks over Internet of Things (RPL-IoT): A Comprehensive Survey, Recent Advances, Recommendations, and Future Directions," to appear in *Journal of Network and Computer Applications,* (WoS/JCR, 2020 IF = 6.281), Elsevier, vol. 207, p. 103476, November 2022.
[5] Khalid A. Darabkh, Jumana N. Zomot, Zouhair Al-qudah, and Ala' F. Khalifeh, "Impairments-Aware Time Slot Allocation Model for Energy-constrained Multi-Hop Clustered IoT Nodes Considering TDMA and DSSS MAC Protocols," *Journal of Industrial Information Integration* (WoS/JCR, 2020 IF = 10.615), Elsevier, vol. 25, p. 100243, January 2022.
[6] Khalid A. Darabkh, Jumana N. Zomot, Zouhair Al-qudah, "EDB-CHS-BOF: Energy and Distance Based Cluster Head Selection with Balanced Objective Function Protocol," *IET Communications, Special Issue: Future of Intelligent Wireless LANs*, (WoS/JCR, 2018 IF = 1.779), IET, vo. 13, no. 19, p. 3168 – 3180, November 2019.
[7] Khalid A. Darabkh, Muna Al-Akhras, Ala' F. Khalifeh, Iyad F. Jafar, and Fahed Jubair, "An Innovative RPL Objective Function for Broad Range of IoT Domains Utilizing Fuzzy Logic and Multiple Metrics," Expert Systems with Applications, (WoS/JCR, 2020 IF = 6.945), Elsevier, vol. 205, p.117593, November 2022.

28. Additional information:

Students are assumed to have sufficient knowledge pertaining to probability theory.

Name of Course Coordinator: **Prof. Khalid A. Darabkh**

Signature: 

Date: **9-9-2022**