COURSE OUTLINE

Department:	Faculty of Computing	**Knowledge Group/ Track:**	Networks / ioT track	
Programme:	MSIT, MSCS	**Class:**	MSIT, MSCS	
Course code:	IT-863	**Academic Session/Semester:**		Spring 2024
Course name:	Internet of Things	**Pre/co requisite (course name and code, if applicable):**		NA
Credit hours:	3+0			

Course Synopsis	This course focuses on the fundamentals of the Internet of Things (IoT) and its technology stack. As of today, IoT is one of the fast-growing technologies worldwide and increasingly becoming pervasive in enhancing various verticals ranging from civilian to defense sectors. These domains include agriculture, environment, healthcare, education, manufacturing, livestock, water, etc., which are presently transforming their traditional infrastructure to support IoT. The unprecedented advancement in technology has made it possible to envisage persistent connectivity, storage, and computation, which, in turn, gives rise to building different IoT solutions. Therefore, it is very important to learn the fundamentals of this emerging technology. The learning outcomes of this course include the understanding of the significance of the Internet of Things, its architecture, and communication protocols. In addition, it will help the students to explore the relationship between IoT, cloud computing and big data, and business benefits of an IoT solution			
Course Learning Outcomes (CLOs)	At the end of the course, the student will be able to**:** 1. Describe the main elements that structure an IoT system. 2. Differentiate between the layers of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack. 3. Build a working IoT system involving prototyping, programming, and data analysis. 4. Evaluate the role of big data, machine learning, cloud/fog/edge computing, and data analytics in a typical IoT solution.			
Course Schedule	Monday (SEECS CR-5) Thursday (SEECS CR-5)			
Course Instructor	**Name**	**Office**	**Contact no.**	**E-mail**
	Professor. Dr. Rafia Mumtaz	A-203	051-90852161	rafia.mumtaz@seecs.edu.pk

Details on Innovative Teaching & Learning (T&L) practices that will be used during the course:

No.	Type	Implementation
1.	Active learning	Conducted through in-class or hands-on activity.
2.	Cooperative learning	Conducted through a design project and class activities. Students will be given several class activities and a project in group. The project requires the design and development of a solution based on IoT sensors and cloud based analytics.
3.	Blended learning	Conducted through the Learning Management System (LMS) of NUST. All information as well as materials related to teaching and learning activities will be shared with the class through this system. Some formative assessments will be also conducted using this system.

Weekly Schedule:

Week 1	Introduction to IoT Why is IoT important? Trends in the Adoption of IoT IoT Architecture and Technology Stack Applications of IoT
Week 2	Sensing Assignment No. 1
Week 3	Actuation Embedded Systems
Week 4	Embedded Systems Networking standards and technologies Assignment No. 2
Week 5	Network Access & Physical Layer IoT Network Technologies Internet Layer IoT Network Technologies Semester Project Assignment and Brief Description
Week 6	Application Layer IoT Network Technologies Possible Industry guest lecture- Industry IoT Protocols Wireless Sensor Networks
Week 7	Embedded system programming (Arduino) Tinkercad-based video demonstrations of sensors and actuators. Assignment No. 3
Week 8	Introduction and Implementation of IoT with Raspberry Pi Introduction to Nvidia Nano Jetson (optional) Project Assignment and Group Formation
Week 9	**Mid-Semester Break**
Week 10	Cloud Computing, Fog Computing, Edge Computing Big Data Analytics and the Internet of Things (IoT) Possible Industry guest lecture- EdgeAI
Week 11	Role of Machine Learning in IoT IoT Verticals (Smart cities) IoT Verticals (Healthcare and Agriculture) Interim project progress report 1
Week 12	IoT Verticals (Industrial IoT) IoT in Agriculture (Case Study 1) Urban Air Quality Monitoring using IoT (case study) Indoor Air Quality Monitoring using IoT (case study)
Week 13	IoMT in Healthcare Introduction and Architecture Basics of Wearable Health Monitoring System (WHMS)

	Need for Wearable IoMT Systems Pilot case study introduction Role of IoT for Cardiovascular Patient Monitoring Interim project progress report 2
Week 14	Existing System for monitoring cardiovascular patients (Traditional vs Smart) Hardware requirements for a Digital Cardiovascular system Sensor Interfaces – ECG, EEG, PPG, Pulse Oximeter, Temperature Sensors, and Pressure Sensors Microcontroller, communication modules Wireless Body Area Network (WBAN) WBAN Architecture and Topology Comparison of multiple communication topologies for the pilot case study Assignment No. 4
Week 15	Data Handling and Analysis Edge/fog/ cloud computing Data Visualization Possible guest lecture from industry
Week 16	Data Security Challenges of IoT Possible guest lecture from industry – IoT Security
Week 17	Project presentations, demo, viva, and report submission
Week 18	**End Semester Break**

Assessment Methods:

	Assessment	Percentage
1	Quizzes (10-15%)	10%
2	Assignments (5-10%)	10%
3	Mid-Term Exam (25-35%)	30%
4	Project (0-20%)	10% [2 % of these marks are allocated to class participation, see “Grading policies” section]
5	End-Semester Exam (40-50%)	40%
Grand Total		**100**

Learning resources:

Textbook

1. Internet of Things (IoT): Principles, Paradigms and Applications of IoT by Kamlesh Lakhwani, Hemant Kumar Gianey, Joseph Kofi Wireko, Kamal Kant Hiran, 2020
2. The Internet of Things” by Samuel Greengard, MIT press, 2015

Reference Books:

1. Internet of Things: Architectures, Protocols and Standards, by Simone Cirani, Gianluigi Ferrari, Marco Picone, and Luca Veltri, 1st edition, Wiley,2019
2. A Reference Guide to the Internet of Things, Bridgera LLC, RIoT, 2017

Grading Policy:

Quiz Policy:

The quizzes will be unannounced / announced and normally last for ten minutes. The question framed is to test the concepts involved in last few lectures. Number of quizzes that will be used for evaluation is at the instructor's discretion.

Project Policy:

Students will be required to develop a project during the course which should be completed towards the end of the semester. They will be graded based on project deliverables and presentation at the end. Students will work in a group/team for projects. A group of 3 students is recommended. At most 4 students are allowed.

Assignment Policy:

In order to develop comprehensive understanding of the subject, assignments will be given. Late assignments will not be accepted / graded. All assignments will count towards the total (No 'best-of' policy). The students are advised to do the assignment themselves. Copying of assignments is highly discouraged and violations will be dealt with severely by referring any occurrences to the disciplinary committee. The questions in the assignment are meant to be challenging to give students confidence and extensive knowledge about the subject matter and enable them to prepare for the exams.

Class participation:

The students are encouraged to participate in class by actively taking part in asking questions from the instructor, sharing his/her thoughts about the topic under discussion, replying to instructor questions, contribute in project presentation and demo. The class participation will be recorded by the instructor and 2% of project marks are assigned to student class participation.

Plagiarism:

SEECS maintains a zero-tolerance policy towards plagiarism. While collaboration in this course is highly encouraged, you must ensure that you do not claim other people's work/ ideas as your own. Plagiarism occurs when the words, ideas, assertions, theories, figures, images, programming codes of others are presented as your own work. You must cite and acknowledge all sources of information in your assignments. Failing to comply with the SEECS plagiarism policy will lead to strict penalties including zero marks in assignments and referral to the academic coordination office for disciplinary action.