**Makerere University**

**College of Computing and Information Sciences**

**School of Computing and Informatics technology**

**End of Semester I exam 2019/2020**

**PROGRAM:** MASTER OF SCIENCE IN DATA COMMUNICATIONS & software engineering

**COURSE NAME:** INTERNET OF THINGS

**YEAR OF STUDY:**  1

**COURSE CODE:** MCN 7110

**DATE:** 2ND December 2019

**TIME:** 4PM

**INSTRUCTIONS**

1. **ATTEMPT ANY FOUR QUESTIONS**
2. **ALL ROUGH WORK SHOULD BE IN YOUR ANSWERS BOOK**
3. **DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO**
4. **THE EXAMS RUNS FOR THREE HOURS**
5. **ATTEMPT EACH QUESTION BEGINNING ON A NEW PAGE**

**Question 1**

1. Explain the difference between Adaptation and adoption (3 Marks)

counterparts, simplifying the deployment model and operations.

**Ans**:Adaptation, Application Gateways must be implemented to ensure translation between IP and Non-IP while Adoption involves replacing all non-IP with their IP counterparts.

1. Evaluate the pros and cons of IP adoption versus adaptation (4 Marks)
2. While the Internet Protocol is key for a successful Internet of Things, constrained nodes and constrained networks mandate optimization at various layers and on multiple protocols of the IP architecture. What are some of these optimizations already available from the market or under development by the IETF? (6 Marks)

ANSWER **From 6LoWPAN to 6Lo, 6TiSCH, RPL**

1. Explain the key differences between TCP and UDP. What are the key challenges of using TCP with IoT/Constrained Networks? (6 Marks)

**Ans:**Reliability, retransmission of packets, amount of data transmitted, Nature of connection, Session requirement.

1. Because of the diverse types of IoT application protocols, there are various means for transporting these protocols across a network. What are the transport methods for the following IoT application protocols (6 Marks)?
   1. Supervisory control and data acquisition (SCADA)

**Ans:** Raw sockets and protocol translation

* 1. Generic web-based protocols: Generic protocols, such as Ethernet, Wi-Fi, and 4G/LTE

**Ans**: HTTP/HTTPs or web sockets

* 1. IoT application layer protocols

**Ans** MQTT and CoAP

**Question 2**

1. What is the key difference between IT and IoT? (1 Mark)
2. As more OT systems become connected to IP networks, their capabilities increase, but so does their potential vulnerability, Traditional models of IT security are simply not designed for the new attack vectors introduced by highly dispersed IoT systems, For optimum security, what mechanisms should IoT systems be able to do to address this security challenge. (5 Marks)
3. What are the some of the unique challenges posed by IoT networks and how have these challenges driven new architectural models? (5 Marks)
4. In 2014 the IoTWF architectural committee published a seven-layer IoT architectural reference model. Each of the seven layers is broken down into specific functions, and security encompasses the entire model. Briefly describe the functionality of each of the layers (14 Marks)



**Question 3**

1. What major challenges do constrained nodes and networks pose for IoT connectivity in the last mile. (6 Marks)
2. How might Internet Address (IPv6) affect the development and implementation of the Internet of Things? (3 Marks)
3. Explain the role of the following new metrics and how they are used for routing by IPv6 Routing Protocol for Low Power and Lossy Networks (RPL) (12 Marks)
4. Hop Count
5. Latency
6. Link Quality Level
7. Node State and Attribute
8. Node Energy
9. Throughput
10. Challenges still exist for IP in IoT solutions. Therefore, optimizations are needed at various layers of the IP stack to handle the restrictions that are present in IoT networks. Discuss the optimizations necessary for IP. (4 Marks)

**Question 4**

1. There are myriad different sensors available to measure virtually everything in the physical world, discuss ways how these sensors can grouped and/or clustered into different categories (5 Marks)
2. While Sensor networks can theoretically be connected in a wired or wireless fashion, what are some advantages and disadvantages that a wireless-based solution offers? (5 marks)
3. While smart objects often collect too much data, in most cases, the processing location is outside the smart object or the cloud. Does this model have any advantage? The model is also known to have some limitations, new requirements appear, and those requirements tend to bring the need for data analysis closer to the IoT system, what are these requirements? (5 Marks)
4. Explain the differences between edge, fog and cloud computing? when architecting an IoT network, what factors should you consider when deciding on where data should be analysed? (5 Marks)
5. Among the access technologies available for connecting IoT devices, three main topology schemes are dominant: star, mesh, and peer-to-peer, explain these topologies. Explain which topology is suitable for each of the following Long Range, Short Range and Medium Range technologies? (5 Marks)

**Question 5**

1. Give one major difference between a sensor and an actuator (2 marks)
2. Explain three physical properties of sensor nodes that make them suitable to be deployed in remote locations (6 marks)
3. Explain two factors you would consider when choosing a sensor radio technology (4 marks)
4. Explain the following sensor network deployment technologies, giving example applications and reasons for choosing the deployment method (6 marks)
   1. Random
   2. Pre-determined
5. Explain why the following conditions must be met in wireless sensor networks (4 Marks)
   1. Algorithms should be localized in the sensor nodes
   2. The networks should be self-configuring
6. The Northern part of the country was recently hit by an earthquake, which destroyed the entire communication infrastructure. Despite the challenge, government is looking for means to communicate so as to rescue people who were affected in the shortest time possible. Giving reasons and using wireless sensor network skills, please advise government on how it can solve the communication problem as soon as possible. (3 marks)