Introduction to IoT QB for Final:

Lecture 1- Basics of IoT

1- Define IoT
2- List the IoT Architecture Layers
3- In the IoT architecture, the data is collected through the _____ layer and transferred over the _____ layer to cloud servers and users connect to the system through _____ layer.
4- Draw typical diagram of IoT Architecture.
5- Define Perception (Sensing) Layer and provide five examples of IoT sensors.
6- Define Network Layer
7- Define Application Layer
8- Define Sensors
9- Data produced from _____ is then electronically transformed, by another device, into information (output) that is useful in _____ done by devices or individuals.
10- What are the selection factors and challenges of IoT Sensors?
11- What are the selection factors and challenges of IoT Networks?
12- Define Intelligent Analysis and list the challenges of IoT Intelligent Analysis.
13- List five of IoT Application Domains.

Lecture 2- IoT Hardware and Devices

1. The IoT hardware are _____ that make IoT possible
2. List four reasons to learn About IoT Hardware?
3. IoT sensors converts _____ about the environment into _____.
4. Compare between Active and Passive sensors.
5. List seven types of sensors and provide a brief about their functions and applications.
6. Describe three types of actuators used in IoT and how they function.
7. What are the common power sources for IoT devices?
8. What are the two IoT applications that depend on mains electricity?
9. Batteries are a common solution for _____ IoT devices. The application will determine if it makes sense to use _____ or _____ batteries.
10. Define Harvesting (Renewable Sources), and list some of the types indicating the most common one.
11. Microcontrollers and microcomputers act as the _____ of smart devices.
12. Compare between Microcontrollers and Microcomputers
13. A microcontroller typically has very little _____ compared to microcomputers.
14. What are the main differences between Raspberry Pi and Arduino?
15. How does Raspberry Pi use Python in IoT development?
16. The 40-pin header on Raspberry Pi is called _____.
17. The basic Python editor that comes with Raspberry Pi OS is called _____.

Lecture 3- IoT Communication Protocols

1- The IoT protocol stack can be mapped to the _____ layers in the _____ model.
2- IoT smart devices connect through the _____ to connect to the application server.
3- _____, MQTT, CoAP, and XMPP are examples of application layer protocols.
4- UDP and TCP are _____ layer protocols.
5- RPL, IPv6, and IPv4 are examples of _____ layer protocols.
6- _____ is the adaptation layer in the IoT stack.
7- Bluetooth is based on the IEEE _____ standard, with theoretical transfer rate of _____ and a range of _____ and the frequency band is _____ and _____ address.
8- In Bluetooth, _____ mechanism associate & authenticate is used, with master _____, slave _____, where multiple devices can connect to same _____.
9- _____ standard is a base for Base for ZigBee, Thread, WirelessHART.
10- IEEE 802.15.4 bitrate is up to _____, with a range _____, and it uses different frequency bands: _____, _____, and _____.
11- IEEE 802.15.4 MAC addresses size are _____ or _____.

12- Explain the main purpose of Z-Wave protocol.
13- Z-Wave operates in the _____ frequency band and flows the standard _____ with data rate up to _____.
14- List the Z-wave Layers and brief each one of them.
15- Explain the difference between Z-Wave controllers and slaves
16- What are LPWANs, and give an example of a long-range protocol used for LPWANs?
17- Define LoRaWAN and Sigfox and brief each one of them.
18- Compare between LoRaWAN and Sigfox?
19- IPv6 uses _____ bit addresses.
20- Why IPv6 is useful for IoT?
21- List the challenges for using IPv6 over 802.15.4
22- 6LoWPAN provides _____ of IPv6 packets into 802.15.4 frames.
23- List the main features of 6LoWPAN.
24- Compare and contrast TCP and UDP.
25- _____ is a transport layer protocol that provides error control and flow control.
26- List three of IoT Application Layer Protocols.
27- Define CoAP.
28- CoAP is based on _____ model and works over _____
29- CoAP is similar to HTTP and runs over _____ .
30- CoAP architecture is divided into two main sub-layers: _____, and _____.
31- CoAP is a Client-Server interaction with server as _____, and client is _____.
32- Draw the CoAP Architecture diagram.
33- MQTT is based on _____ model and works over _____
34- Describe the Publisher-Subscriber model

35- Draw the MQTT Architecture diagram.
36- Define XMPP
37- XMPP is based on _____ and _____ model.
38- _____ is a IoT short-range protocol.
39- XMPP is used for transmission of _____, _____, and _____.
40- Draw the XMPP Architecture diagram.

Lecture 4- IoT and Cloud

1- What is cloud computing in the context of IoT, and why is it important for IoT applications?
2- Cloud computing enables users to perform computing tasks using services provided over the _____.
3- Combining IoT with cloud computing addresses the challenge of storing, processing, and accessing large amounts of _____ generated by _____.
4- What are the benefits of using a cloud platform for IoT?
5- Define ThingsBoard. and list its core functionalities.
6- Cloud computing allows IoT devices to perform computations using services over the Internet. (T/F)
7- IoT systems do not benefit from cloud computing for handling large amounts of sensor data. (T/F)
8- IoT cloud platforms typically provide multiple connectivity options for devices. (T/F)
9- Using an IoT cloud can improve collaboration among users. (T/F)
10- Most IoT cloud platforms do not support encryption or authentication for data. (T/F)
11- ThingsBoard _____ Advantage allows customization, and community support.
12- Since ThingsBoard ability to handle a large number of devices and high data volumes, ensures robust _____ for critical IoT deployments.
13- Users can build custom _____ in ThingsBoard to visualize data and monitor device performance.
14- The ThingsBoard _____ enables automated responses to certain events by integrating with external systems.
15- Explain why MQTT protocol is the best option for ThingsBoard?
16- List the ThingsBoard System Architecture components.
17- Devices use MQTT to send data to a cloud-based MQTT _____, acting as a _____ for data injection into the ThingsBoard platform
18- ThingsBoard is an open-source IoT platform that supports device management and data visualization. (T/F)
19- Because ThingsBoard is open-source, it cannot be customized by users. (T/F)
20- ThingsBoard is designed to scale and handle a large number of IoT devices. (T/F)
21- ThingsBoard's rule engine cannot integrate with external systems or services. (T/F)
22- ThingsBoard dashboards allow real-time monitoring of sensor data. (T/F)
23- ThingsBoard can send alerts or notifications based on data thresholds. (T/F)
24- MQTT is a lightweight messaging protocol ideal for devices with limited bandwidth. (T/F)
25- MQTT uses a request–response model for communication. (T/F)
26- MQTT QoS levels help ensure messages are delivered reliably. (T/F)
27- MQTT does not support any form of encryption or security. (T/F)
28- ThingsBoard processes incoming device data using a _____ engine that can filter and react to events before storing the data.
29- ThingsBoard system is hosted on a cloud infrastructure, providing 1) _____, 2) _____, and 3) _____, for IoT solutions.
30- Users interact with ThingsBoard through a web _____, where they can configure devices, dashboards, and rules.
31- Draw ThingsBoard Architecture Diagram.
32- List ThingsBoard Visualization Options.
33- Real-time widgets in ThingsBoard help monitor _____.
34- ThingsBoard enables instant feedback on _____ performance and environmental conditions.
35- Historical data can be analyzed to identify _____, _____ , and _____.
36- Predictive _____ can be enabled through historical data analysis in ThingsBoard.
37- ThingsBoard allows users to set up alerts based on _____.
38- _____ in ThingsBoard help ensure timely responses to critical events and potential issues.
39- Define ThingsBoard Rule Engine, and ThingsBoard Rule Chains and explain their relationship.
40- Each logic block in a Rule Chain is called a _____.
41- The Rule Engine determines what automated _____ should be taken based on logic.
42- Rule Chains consist of multiple _____ and _____.
43- List the ThingsBoard Rule Chain Actions and explain each point.
44- In ThingsBoard's architecture, an MQTT broker serves as the entry point for device data. (T/F)
45- ThingsBoard cannot automate any responses to incoming data. (T/F)
46- Users interact with ThingsBoard through a web-based interface. (T/F)

47- Imagine you want to display a sensor's current reading (e.g., the current temperature) on a dashboard, alongside a graph of its values over the past week. Which widget type would you use for the current reading and which for the historical trend, and why?

48- You need to allow a user to remotely toggle an LED light on an IoT device from the dashboard. What type of widget would you add to the dashboard to achieve this, and why?

49- Suppose you want your dashboard to clearly show if any device has triggered an alarm (for example, an over-temperature alarm). Which widget type would be suitable for displaying active alarms, and why?

50- You are designing a dashboard for a smart building. The dashboard should include: a map of the building with sensor locations, real-time readings for key metrics, and a control to reset an alarm. Identify at least two different widget types you would use and explain their roles in this dashboard.

Lecture 5- IoT Security

1- List the Key IoT Security Challenges?
2- Many IoT devices use _____ passwords, making it easy for attackers to gain access.
3- _____ IoT devices on a network can be used to steal data or launch attacks.
4- While majority of IoT device network traffic is _____, putting confidential data at risk.
5- IoT health devices like _____ and _____ when transmitting data without encryption, will create vulnerabilities for malware attack such as _____ .
6- The _____ and _____of IoT products limit the budget for developing and testing secure _____, leading to potential weaknesses.
7- Without built-in security, IoT devices become vulnerable to _____ forms of attack (even very simple ones).
8- Explain why an attack on one IoT device can spread easily to others?
9- Explain why IoT devices communications are easier to intercept?
10- The use of _____ technology in cars has led to notable IoT data breaches.
11- Many manufacturers do not focus on making IoT hardware _____-proof, leaving devices physically vulnerable.
12- One IoT security challenge is the difficulty in _____ and updating devices in the field.
13- Many IoT devices are not designed to receive IoT Security_____, increasing their vulnerability.
14- Without built-in security in IoT device, it's difficult to: 1) _____, 2) _____, and 3) _____ .
15- Draw the diagram of Key IoT Security Challenges.
16- List the Effective Solutions for IoT Security Challenges.
17- To resist weak authentication three solutions can be suggested: 1) _____ 2) _____, and 3) _____
18- Continuously monitoring IoT traffic can help business owners to _____.
19- List the tools that can be used to Implement Device and Network Monitoring in IoT world.
20- As IoT devices handle more personal data, it's important to consider how users give _____ for data usage.
21- Explain why Regular IoT device Firmware and Software Updates is important?
22- Hackers can more easily target IoT systems that have outdated firmware. (T/F)
23- Regular updates have no impact on the battery life or performance of IoT devices. (T/F)
24- It's acceptable to never update IoT devices as long as they appear to work, since updates are not crucial. (T/F)
25- An IoT device's architecture can be described as a three-layer stack: 1) _____ 2) _____, and 3) _____
26- Define IoT device firmware and list its components.
27- Explain why we need to perform Over The Air Updates for IoT devices?
28- Draw the diagram for IoT OTA Firmware Update Architecture.
29- The device management server used in OTA operations usually runs on the internet (cloud) to communicate with devices.
30- For security reasons, IoT device should not perform firmware update at all during its life time. (T/F)
31- An authorized IoT software maintainer should be able to: 1) _____, and 2) _____
32- List the Problems and Solutions for OTA Updating.
33- Link the problem to a solution for OTA Updating from below

OTA Problem		OTA Solution
Limited memory and processing power		Use The storage blocks evenly
Battery Powered		Digital Signature for the Firmware Update
Firmware Update Failure		Differential Updates
Flash memory degradation		Dual Firmware
Malware is injected in the firmware during the update		

34- Why lightweight algorithms in software as well as hardware-based acceleration of cryptographic operations should be considered in IoT device?
35- Why firmware update size minimization is important?
36- Explain the IoT Device Differential Updates Procedures.
37- A _____ contains the difference between the new firmware version and the current version.
38- After creating the differential file, it is pushed to the cloud server and devices are _____ of the available update.
39- A differential update contains the entire new firmware image in full, resulting in a large data transfer. (T/F)
40- In differential updates, only the changes (differences) between the old and new firmware are sent to the device. (T/F)
41- Differential updates reduce the amount of data that must be downloaded, saving _____ .
42- The IoT device pull the differential file and add it to the _____ firmware to generate the _____ firmware.
43- Explain the in-place approach for IoT device firmware update and indicate its two drawbacks.
44- In a dual firmware strategy, the device cannot test the new firmware before permanently switching to it. (T/F)
45- If the new firmware is validated as successful in a dual firmware system, the device will keep running the new firmware and may discard the old one. (T/F)
46- Explain the procedures of IoT Device Dual Firmware Update
47- Draw the diagram of IoT Device Dual Firmware Update
48- Explain why IoT device suffers from flash memory degradation problem.
49- Flash memory in IoT devices can degrade over time due to many erase and write operations during firmware updates. (T/F)
50- In IoT device flash memory, when the erase threshold of a block has been reached, then it can be used in the future to store firmware. (T/F)
51- Explain how to increase the lifetime of IoT device flash memory.
52- Explain how to achieve a uniform and smooth degradation of the available storage blocks in IoT device.
53- Why it is of importance for IoT nodes to be supported by a secure OTA mechanism.
54- The Zigbee Worm was able to trigger a chain reaction of infections, starting from a single compromised IoT device (a light bulb) using a malicious firmware _____.
55- The vendor must better secure their _____ to avoid replacing valid firmware with malicious firmware.
56- The vendor must include _____ in the initial IoT device firmware.
57- Each firmware update must be _____ by the vendor's public key, and the _____ must be attached to the firmware before transmission.
58- After receiving the new firmware, the IoT device must _____ the firmware signature before _____ the new firmware.
59- Draw the diagram of OTA Secure Update Diagram
60- List the IoT Cloud Security Considerations with brief on each point.

Lecture 6- IoT Design Methodology

Q1\ Describe the IoT design methodology

Q2\ The IoT design methodology provides a step-by-step _____ for translating user needs and technical requirements into an operational IoT system.

Q3\ List the Five main structured stages in IoT Design.

Q4\ Draw the diagram of Structured IoT Design Methodology

Q5\ List the benefits of Structured IoT Design

Q6\ Explain the Purpose & Requirements Specification Phase

Q7\ A clear requirement specification ensures that users _____ on what the system is meant to achieve.

Q8\ Design Question: Indicate the Purpose & Requirements Specification for below IoT Projects:

- Pollution Monitoring via Mobile Car
- Speed Violation Detection and Notification System
- Smart Fuel Monitoring System
- Real-Time Tyre Pressure Monitoring System.

Q9\ Explain the Process Specification Phase.

Q10\ For each use case in Process Specification Phase, we need to identify: 1) _____, 2) _____, 3)_____, and 4) _____ .

Q11\ Design Question: Indicate the Process Specification for below IoT Projects:

- Pollution Monitoring via Mobile Car
- Speed Violation Detection and Notification System
- Smart Fuel Monitoring System
- Real-Time Tyre Pressure Monitoring System.

Q12\ Explain the Domain & Information Model Phase.

Q13\ In Domain & Information Model abstraction helps organize the system in terms of _____ and their _____

Q14\ Design Question: Indicate the Domain & Information Model for below IoT Projects:

- Pollution Monitoring via Mobile Car
- Speed Violation Detection and Notification System
- Smart Fuel Monitoring System
- Real-Time Tyre Pressure Monitoring System.

Q15\ Explain the Service Specification Phase.

Q16\ In Service Specification Phase, each service should include: 1) _____, 2) _____, 3)_____, and 4) _____ .

Q17\ Design Question: Indicate the Service Specification for below IoT Projects:

- Pollution Monitoring via Mobile Car
- Speed Violation Detection and Notification System
- Smart Fuel Monitoring System

- Real-Time Tyre Pressure Monitoring System.

Q18\ Explain the Application Design & Integration Phase.

Q19\ The Application Design & Integration Phase, includes: 1) _____, 2) _____, 3)_____, and 4) _____ .

Q20\ Design Question: Indicate the Application Design & Integration for below IoT Projects:

- Pollution Monitoring via Mobile Car
- Speed Violation Detection and Notification System
- Smart Fuel Monitoring System
- Real-Time Tyre Pressure Monitoring System.