INDUSTRIAL INTERNET OF THINGS
(AEIE 5243)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) The modulation technique used for NB-IoT devices is:
(a) FSK
(b) QPSK
(c) Chirp Spread Spectrum
(c) Frequency Hop Spread Spectrum

(ii) The standard port used by MQTT is
(a) I2C
(b) SSL
(c) USART
(d) TCP/IP

(iii) The bandwidth used for NB-IoT devices is:
(a) 180 KHz
(b) QPSK
(c) Chirp Spread Spectrum
(c) Frequency Hop Spread Spectrum

(iv) The frequency band used by ZigBee for worldwide application users is
(a) 433 kHz
(b) 868 kHz
(c) 2.4 GHz
(d) 915 kHz

(v) The layer of OSI reference model at which a router operates is
(a) Layer 2 (Data Link)
(b) Layer 3 (Network)
(c) Layer 1 (Physical)
(d) Layer 4 (Transport)

(vi) The maximum data rate in WiFi is
(a) 300 Mbps
(b) 100 Mbps
(c) 150 kbps
(d) 300 kbps

(vii) The application area of a Class A LoRa device is
(a) battery powered sensors
(b) battery powered actuators
(c) mains powered sensors
(d) mains powered actuators

(viii) The multiple access technique used by IEEE 802.11 standard for wireless LAN is
(a) ALOHA
(b) CSMA/CA
(c) CDMA
(d) None of the mentioned

(ix) The foremost attribute of aviation IIoT applications is
(a) Security
(b) Robustness
(c) both (a) and (b)
(d) Connectivity

(x) The protocol layer of LoRa is
(a) MAC
(b) physical
(c) transport
(c) session

Fill in the blanks with the correct word

(xi) The maximum transmission power of Class 3 Bluetooth is _____.

(xii) LoRa is ideal for IIoT applications requiring long-range communication and exceptionally long _____.

(xiii) The Intel-VT of IaaS cloud service is a type of _____.

(xiv) The IaaS cloud service is mostly used in _____.

(xv) The IEEE standard used by Zigbee is _____.

Group - B

2. (a) What do you understand by value chain in an IIoT solution? *[(CO3)(Analyse/HOCQ)]*
(b) Contrast why IIoT systems require different protocols other than HTTP to communicate. *[(CO2)(Understand/LOCQ)]*
(c) What are the various capillary network devices used in IIoT? What advantage do capillary networks have? *[(CO2)(Apply/IOCQ)]*

3 + 4 + (3 + 2) = 12

3. (a) Compare radio protocols for M2M for indoor and outdoor applications. *[(CO3)(Analyse/HOCQ)]*

(b) What are piconets in a Bluetooth network? How many devices can be connected in a Bluetooth piconet? *[(CO4)(Remember/LOCQ)]*

(c) List a few reasons for using Zigbee over Bluetooth. *[(CO2)(Apply/IOCQ)]*

4 + (3 + 2) + 3 = 12

Group - C

4. (a) What are the design principles of RESTful API? Name the data representation formats used by RESTful API. *[(CO3)(Analyse/HOCQ)]*

(b) Examine the role of the PAN coordinator in a peer-to-peer communication network. *[(CO5)(Remember/LOCQ)]*

(c) List down some applications where the Bluetooth network is used. *[(CO2)(Apply/IOCQ)]*

(3 + 3) + 4 + 2 = 12

5. (a) Differentiate between radio protocols for indoor and IoT applications based on datarate over battery life. *[(CO3)(Analyse/HOCQ)]*

(b) Explain what a Bluetooth scatternet is. List the differences Bluetooth has over ZigBee protocol. *[(CO4)(Remember/LOCQ)]*

(c) Identify the data rate range of Bluetooth low-energy devices. *[(CO2)(Apply/IOCQ)]*

4 + (3 + 3) + 2 = 12

Group - D

6. (a) What benefit does real-time scheduling provide in the case of LoRa networks? *[(CO3)(Analyse/HOCQ)]*

(b) Contrast the role of 3GPP standards for IIoT communication protocols. What is the role of a PAN coordinator in a Zigbee network? *[(CO3)(Analyse/HOCQ)]*

(c) Interpret the physical layer modulation technique LoRa modules use. *[(CO2)(Apply/IOCQ)]*

4 + (4 + 2) + 2 = 12

7. (a) What benefits does the NB-IoT network have over LoRa? *[(CO3)(Analyse/HOCQ)]*

(b) Explain what you understand by the XaaS cloud service model. Explain in detail what role the security layer plays in IIoT functional layers. *[(CO4)(Remember/LOCQ)]*

(c) What is the advantage of using mesh networking in IIoT applications? *[(CO3)(Analyse/HOCQ)]*

4 + (3 + 3) + 2 = 12

Group - E

8. (a) What are the advantages of wired sensor connectivity? *[(CO3)(Analyse/HOCQ)]*

(b) List down the various advantages of cellular M2M networks. Show using an example what role predictive maintenance plays in IIoT services. *[(CO5)(Remember/LOCQ)]*

(c) What is the frequency bandwidth for ZigBee? *[(CO4)(Remember/LOCQ)]*

4 + (2 + 4) + 2 = 12

9. (a) What do you understand by the service support layer in an IIoT system? *[(CO3)(Analyse/HOCQ)]*

(b) What is the role of hypervisor in the IaaS cloud service model? What do you understand by emulation? How many types of emulation are there? *[(CO4)(Remember/LOCQ)]*

(c) Outline using an example the role of data analytics in IIoT service. *[(CO2)(Apply/IOCQ)]*

4 + (2 + 2 + 2) + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	16.7	40.6	42.7

Course Outcome (CO):

After the completion of the course students will be able to

1. Determine the IIoT architecture and application in various fields.
2. Distinguish building blocks of Internet of Things and characteristics.
3. Outline the concept of NB-IoT and LoRa.
4. Realize the importance of security and privacy issues in IIoT.
5. Interpret the concept of IIoT and M2M.
6. Point out the applications of IIoT in various industries.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*