International Institute of Information Technology - Hyderabad

Communication and Controls for IoT

28 February 2023

- Number of questions: 6; Total points: 50; Time Limit: 90 minutes.
- Use of calculator is NOT permitted.
- This is a closed-book exam.
- Write all answers in the answer sheet only. Do not write or mark anything on the question paper.
- Read the questions and marking scheme for each question properly.

---

1. **Multiple Choice Question;** Negative marking: 1 point per correct answer; -0.5 per wrong answer; 0 for not attempting! (Total: **12 points**)

   i. What is the characteristic equation of a linear temperature sensor with no zero offset that provides 2 V output for 25 C?

   (A) T = 7.5 V + 10
   (B) T = V/25
   (C) T = 12.5 V
   (D) T = V/12.5 + 10

   ii. Incandescent light is a transducer that relies on:

   (A) Piezoelectricity
   (B) Electromagnetism
   (C) Black body radiation
   (D) Change in resistance

   iii. The main disadvantage of a SAR analog to digital convertor is:

   (A) Too many resistances
   (B) Long time of conversation
   (C) High power dissipation
   (D) None of the above

iv. A watchdog timer cannot be enabled for:

(A) 0.5 sec (B) 1 sec
(C) 2 sec (D) 8 sec

v. In an Arduino Uno, the millis() timer resets after (approximately):

(A) 3 hours
(B) 4.971 days
(C) 39 days
(D) 49 days

vi. Maximum instantaneous throughput for a node in the network consisting of M nodes on a channel of capacity R bps using Aloha is

(A) 0.18*R bps
(B) R/M bps
(C) 0.37*R bps
(D) R bps

vii. Which protocol cannot be used in outdoor environments?

(A) Bluetooth
(B) IEEE 802.15.4
(C) Both (A) and (B)
(D) None of the above

viii. Idle listening is a major issue in

(A) FDMA
(B) TDMA
(C) CSMA
(D) CDMA

ix. Which one of the following protocols does not have an IP address?

(A) IEEE 802.15.4
(B) LoRaWAN
(C) WiFi
(D) Cat-M1

x. Which one of the following is the best physical layer technology for all IoT applications?

(A) LoRaWAN
(B) Cellular
(C) WiFi
(D) Depends on the application

xi. For which communication technology you cannot make your network?

(A) LoRaWAN
(B) NB-IoT
(C) Both (A) and (B)
(D) None of the above

xii. Which technology does not have transmission bands in Sub-1 GHz

(A) IEEE 802.15.4
(B) IEEE 802.11ah
(C) Bluetooth
(D) LoRaWAN

2. **True or False (With Reasoning)**: 1 mark per bit only if both the statement (T/F) and reasoning are right; 0 otherwise (Total: **8 points**)

i. A car horn is a transducer.

ii. It is better to have a non-linear characteristics for a sensor.

iii. Timers work inside an interrupt service routine.

iv. Simple sensors such as temperature, CO, CO2, and light do not reveal any private data.

v. Interoperability is an important issue in IoT.

vi. IEEE 802.11ah does not support guaranteed quality of service applications

vii. In SDMA, different users can transmit on the same frequency and time, but it is still a fixed assignment protocol.

viii. In MQTT, clients need to know each other's IP addresses.

3. Lets try to create a simple application involving long/short press of a button. Say we connect the button to the interrupt pin of Arduino (pin 2). When the button is pressed, we want a red LED (connected on pin 4) to light up for 1 second. In case the button is pressed for more than 5 seconds (long press), a green LED (connected to pin 5) should light up for 1 second. Write a pseudo code for this application. **(10 points)**

4. Briefly explain five main issues in IoT from a communication perspective? **(5 points)**

5. Elaborate in a few sentences five different important features/modifications made in traditional WiFi to design IEEE 802.11ah standard, which is suitable for IoT applications. **(5 points)**

6. This question is regarding the project you are doing in this course. Write the title of the project and team name before starting to answer the question. **(Total: 10 points)**

   (a) **Problem Statement and motivation:** State and briefly explain the problem statement. What is the importance of the problem statement given to you? (2 points)

   (b) **Selection of components:** Explain which microcontroller, sensors, actuators, type of ADC/DAC (if required), and any other hardware will be required to develop the desired system. Clearly explain the rationale/reason behind selecting every component. (2 points)

   (c) **Communication technology:** Clearly explain, with reasoning, the choice of PHY layer protocol, topology, and MAC layer protocol. Explain the rationale behind your selection using design parameters, such as low power, range, latency, data rate, etc.? (2 points)

   (d) **Block diagram:** Along with a functional block diagram, explain your IoT-based approach, including hardware and software. What were other possible options, and why are you using this approach over other possible approaches? (3 points)

   (e) **Application layer protocol:** Which application layer protocol would you like to use and why? (1 point)