

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
K.K. BIRLA GOA CAMPUS
Mid-Semester Examination 2022-23

Subject Name: Internet of Things: Design and Dev (CS G518)

Date: 5/11/2022

Candidate's Name:

Total Marks: 60

Candidate's Email:

Duration: 90 mins

Candidate's Campus Id:

Examiner: Sougata Sen

Instructions:

Answer all questions. In case you have made any assumption, mention that clearly in the answer sheet. Assumptions not mentioned in your answer sheet will not be considered.

Answer all questions briefly, and to the point. Unnecessary verbosity will be strictly penalized.

Q1. Consider the following code snippet for an ESP32. [Total 18 marks]

```
1 int ledPin1 = 18, ledPin2 = 19, ledPin3 = 17;
2
3 void setup() {
4
5 }
6
7 void loop() {
8   Serial.println("LED Status:" + String(GetLEDStatus(ledPin1)));
9   delay(1000);
10  if (GetLEDStatus(ledPin1) == LOW)
11    if (GetLEDStatus(ledPin2) == LOW)
12      if (GetLEDStatus(ledPin3) == LOW)
13        SetLEDStatus(ledPin3, 1);
14      else
15        SetLEDStatus(ledPin2, 1);
16    else
17      SetLEDStatus(ledPin1, 1);
18  else if (GetLEDStatus(ledPin2) == HIGH)
19    if (GetLEDStatus(ledPin3) == HIGH)
20      SetLEDStatus(ledPin3, 0);
21    else
22      SetLEDStatus(ledPin2, 0);
23  else
24    SetLEDStatus(ledPin1, 0);
25 }
26
27 boolean GetLEDStatus(int pin) {
28
29 }
30
31 void SetLEDStatus(int pin, boolean stat) {
32
33 }
```

a. Will this code display the LED Status on the Serial monitor because of line 8? Mention what is included in the snippet that will allow the proper displaying, or if you believe that the code snippet will not display the LED

status properly, what changes will you make in the code snippet (including the line number where you will make the change) to fix the error?(1+3 mark)

b. What changes are needed in the code to display the output on 3 LEDs connected on pins 17,18, and 19? Mention **all** the line numbers in the current code snippet that you would modify to allow proper displaying of the output on the LEDs. (4 mark)

c. Assume that the *getter* and *setter* functions are correctly getting and setting LED status. What is the output of the program, as observed on the LEDs and Serial Monitor? Consider the starting time as t_0 second. Mention the output at times t_0 to t_{10} . (2 mark)

d. You have connected a toggle switch to pin number 5 of the ESP, such that when someone presses the switch, the LED glowing pattern changes from the original pattern (as indicated by you in Q.1c.) to a digital counter such that ledPin1, ledPin2, and ledPin3 will have the following sequence respectively — t_0 : LLL, t_1 : LLH, t_2 : LHL, t_3 :LHH, t_4 :HLL, t_5 :LLL Here L indicated LOW, and H indicates HIGH. The digital counter will be written in a function with the following signature: void digitalCounter().

i. Draw the circuit's block diagram for connecting the switch to pin 5 of the ESP. Dont worry about pins 17, 18 and 19. (2 mark)

ii. Write the code for the digitalCounter() function (2 mark)

iii. Mention briefly the changes to the existing code that you will do so that the switch can be used to change the LED pattern (4 marks)

Q2. Choose the correct options for the questions below. There can be more than 1 correct option. All correct options must be selected (and incorrect options not selected) to get marks. (6×1 mark = 6 marks)

i. An 6-axis inertial sensor usually consists of:

- (a) an accelerometer sensor
- (b) a gyroscope sensor
- (c) an impedance sensor
- (d) a temperature sensor

ii. An IoT deployment that consists of multiple nodes sending data to a cloud storage is an example of:

- (a) IoT Level-3 deployment
- (b) IoT Level-4 deployment
- (c) IoT Level-7 deployment
- (d) IoT Level-8 deployment

iii. An IP address is associated with:

- (a) a machine
- (b) a router
- (c) an interface
- (d) an ethernet switch

iv. The sensitivity of an ideal $\pm 2g$ accelerometer sensor (e.g., ADXL345) with a 10 bit ADC is approximately

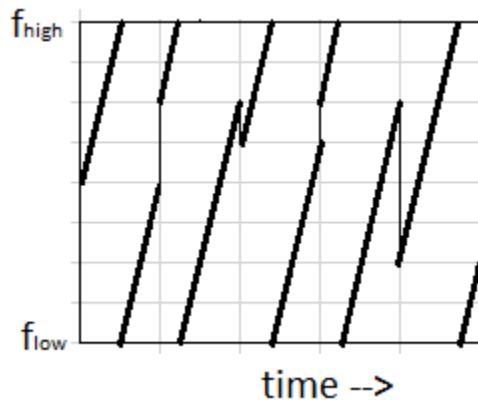
- (a) 1 mg/LSB
- (b) 2 mg/LSB
- (c) 3 mg/LSB
- (d) not determinable

- v. Select all answers that are true about the Active Badge project for tracking doctors in an indoor environment.
- (a) The technology used was infrared, a technology often used in TV remotes.
 - (b) The technology used was GPS, a technology often used for vehicular navigation.
 - (c) The probability of a doctor being at the last detected location increased if no reading from the doctor was obtained at any receiver (including the last detected receiver).
 - (d) The doctors could carry the Active Badge inside their pockets.

vi. Select the correct options below.

- (a) The Contiki MAC protocol requires that all receivers will synchronize and follow the same wakeup-sleep cycle.
- (b) Senders in the Contiki MAC protocol can conserve more energy than a protocol where a sender would wake up, send a packet, and go to sleep again.
- (c) CSMA/CD nodes stop transmission as soon as they detect a collision.
- (d) It is certain that in a room with a lot of Wi-Fi traffic, BLE advertisements will never get through from the transmitter to the receiver.

Q3. What is up-chirp and down-chirp in LoRaWAN signals? For the following LoRaWAN signal (shown in the figure below), assume that the Spreading Factor is 3. What is the encoded message being transmitted? Please provide your answer in bits. If you would like to provide your answer in any other format (octa, hexa, decimal...), ensure you do mention the format. Explain briefly how you arrived at your answer about the transmitted message. [2+4+4 marks = 10 marks]



Q4a. Shorten the following IPv6 address. Explain the steps that you have taken. 2001:0d8f:00f2:0000:0000:06ee:0000:0f11 [1+1 marks]

Q4b. You have a MQTT broker that has the following topics registered:

1. /college/hostel/groundFloor/Temperature/
2. /college/hostel/groundFloor/light/
3. /college/hostel/firstFloor/Temperature/
4. /college/hostel/firstFloor/light/
5. college-mess-A-temperature
6. college-mess-A-light
7. /college/mess/C/temperature/
8. /college/mess/C/light/

Select all the topics that you will hear from when you subscribe for the following topics (You dont have to copy the topic details. Just mentioning their number is okay) ($1 \times 4 = 4$ marks)

(a) /college/hostel/#

(b) /college/hostel/+/Light

(c) college#

(d) /college/mess/#/light

Q4c. You are building the world's longest 6LoWPAN network. There are 20 6LoWPAN nodes that are arranged in a very long chain from the *source* to the *destination*, all performing routing. You decide to send a packet whose first 2 bits are "1" and "0" respectively from the source to the destination. Yet you find that none of your packets reach the destination node. All the routers are configured and functioning correctly. What is wrong? (4 marks)

Q5. Mention (a) one possible use case (or application) of the FabToys project, i.e., who would use it and how, and (b) one limitation of the data collection (for the user study) that was carried out by the authors of the same project. (4 + 4 marks)

Q6. You are using the VH tags for tracking birds in the wild. You would like to determine if the bird is flying or not. If the bird is flying, then the VH tag should log the GPS reading every 10 seconds. If the bird is sitting, and if there are other birds with VH tags nearby, then the tag should send the collected data to the VH tags on the nearby birds. When any bird reaches near the base station, the base station collects all data that is present in the VH tag. This might include data from the bird on which the VH tag is placed, as well as data from all other birds that it encountered. At the base station, there should not be any duplicate entry. For the aforementioned requirement:

- a. Write the purpose and requirement specification of the aforementioned system (2 marks)
- b. Draw the process specification diagram (2 marks)
- c. Describe in one sentence, the process to identify and eliminate duplicates in data. (2 marks)
- d. Describe the strategy that the base station might adopt to get data from the VH tags on the birds. (2 marks)