

## Exam

9 April, 2020

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Howard, Dash

*Instructions:*

- Show all work on the front of the test papers. No work shown may mean 0 points given! If you need more room, make a clearly indicated note on the front of the page, "MORE ON BACK", and use the back. The back of the page will not be graded without an indication on the front.
  - Read each question carefully and follow the instructions. Unless otherwise stated, you must show your work and clearly illustrate your steps.
  - If you round a numerical answer, you must give at least 3 significant digits.
  - Put your name at the top of each test page and be sure your exam consists of the number of pages designated in the headers.
  - The space provided does NOT necessarily represent the amount of writing necessary.
  - You may not use any notes, homework, labs, or other books. Only **memoryless** calculator is allowed.
  - You may not use any notes, homework, labs, or other books.

COMMENTS, FEEDBACK, or any special instructions for the professor:

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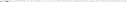
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Problem	Available	Points
1	15	
2	15	
3	15	
4	15	
5	20	
6	20	
<b>Total</b>	100	

**Important:** In completing this exam, I used a calculator with no communications capability, and no information of relevance to the course was stored in the calculator. I did not use any other electronic device or any other references. My work was solely my own.

Your Calculator's Maker and Model#: N/A

Electronic Signature: 

**You must sign this to receive credit for the exam.**

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**Remember to show ALL work here and in EVERY problem on this exam.**

**Q1. (15 pts) [True (T) or False (F)] [3pts for each sub-problem]**

- a) () Embedded Systems are combinations of hardware and software that perform a multiple functions or perform multi functions within a larger system.
- b) () Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software.
- c) () Raspberry Pi is a series of small multi-board computers.
- d) () The Raspberry Pi should be shutdown via a software process and Arduino stops when lose power.
- e) () In IoT system, every IoT devices need to connect to the internet directly.

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### Q2. (15 pts.)

- (a) (7 pts) Draw the General Block diagram of IoT. Explain the role of Sensors, Microcontroller, and Actuators in an IoT System.

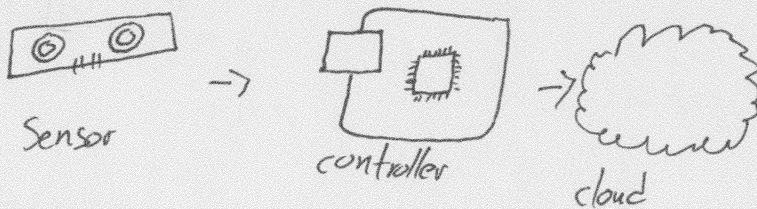
Sensor → Controller → gateway → Cloud → gateway → controller → Actuator

Sensors read Analog input, converts it to an electrical signal and sends to microcontroller

Microcontroller reads that input. Depending on how its programmed, it may do operations on it for humans to read. Or it may send out the direct signal for analysis.

Actuator takes an electrical signal and converts it back into analog.

- (b) (5 pts) A microcontroller-based home security system has to be designed. This system should detect a movement within a range of 20 ft and log the time of the movement. Draw an IoT system diagram showing the sensor and interfaces.



- (c) (3 pts) In Raspberry Pi, can a GPIO pin be configured either as input or output? Explain.

Yes, it can. The name itself tells this, General Purpose Input/Output.

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### Q3. (15 pts)

- (a) (5 pts) You would like to write a short python program which prints “Hello World”. Discuss the use of following commands to run your “Hello World” program.

i. \$ nano helloworld.py

*this tells your computer to attempt to run  
your py code/file*

ii. #!/usr/bin/python3

*this tells your computer where python3  
library is to run your code with*

- (b) (10 pts) What is wrong with the following Python code segment? This code will help the servo motor mounted camera to rotate 180 degree every 10 sec.

```
import RPi.GPIO as GPIO
import time      # time module support sleep function
GPIO.setmode(GPIO.BCM)

GPIO.setup(18, GPIO.OUT)
GPIO.output(18, GPIO.HIGH)

pwm = GPIO.PWM(18, 50)    # set frequency at 50Hz for 20 ms period

while(1):
    pwm.start(5)
    time.sleep(2)
    pwm.ChangeDutyCycle(6)
    time.sleep(2)
    pwm.ChangeDutyCycle(7)
    time.sleep(2)
    pwm.ChangeDutyCycle(8)
    time.sleep(2)
    pwm.ChangeDutyCycle(9)
    time.sleep(2)
    pwm.ChangeDutyCycle(10)
    time.sleep(2)
```

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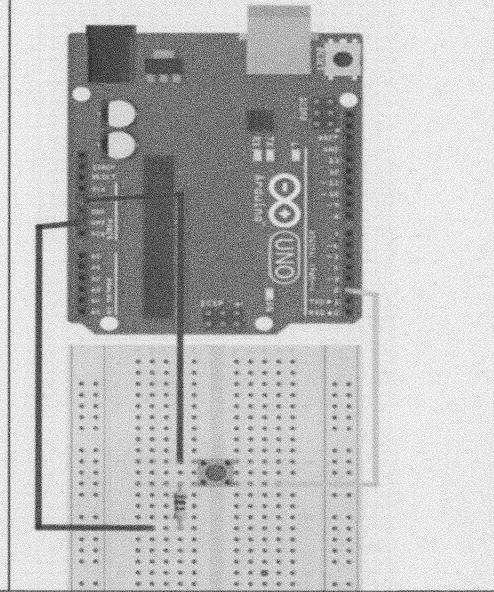
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Howard, Jah  
Last Name , First Name**Q4. (15 pts)**

- (a) (9 pts) What is wrong with the following Arduino code segment based on circuit connection shown in Figure below?

/\*Read the pushbutton switch using a digital pin. The buttonState will high when the pushbutton switch is press\*/

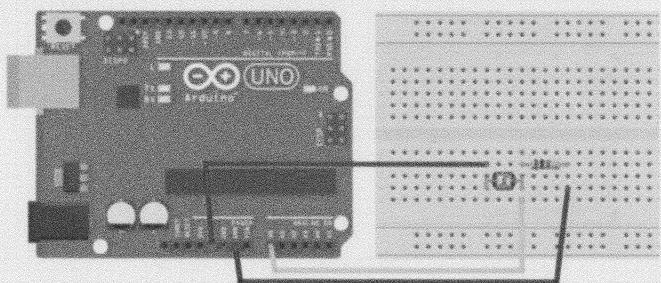
```
const int buttonPin = 3;  
  
int buttonState = 0;  
void setup() {  
    pinMode(buttonPin, INPUT);  
    Serial.begin(9600);  
}  
  
void loop() {  
    buttonState = analogRead(buttonPin);  
    Serial.print("button = ");  
    Serial.print(buttonState);  
    Serial.print("\n");  
    delay(200);  
}
```



- (b) (6 pts) What is wrong with the following Arduino code segment based on circuit connection shown in Figure below?

/\*you want to turns ON the light bulb when there is no lights around by reading LDR data.  
Turns OFF when not required\*/

```
int LDRval = HIGH;  
void setup() {  
    Serial.begin(9600);  
}  
void loop() {  
    analogRead(A0);  
    LDRval = digitalRead(A1);  
    // print the value to the serial monitor  
    Serial.print("LDRval = ");  
    Serial.print(LDRval);  
    Serial.print("\n");  
}
```



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## Q5. (20 pts)

- (a) (15 pts) What is wrong with the following code segment based on circuit connection shown in Figure below?

*/\*you want to measure the distance using ultrasonic sensor and Raspberry Pi\*/*

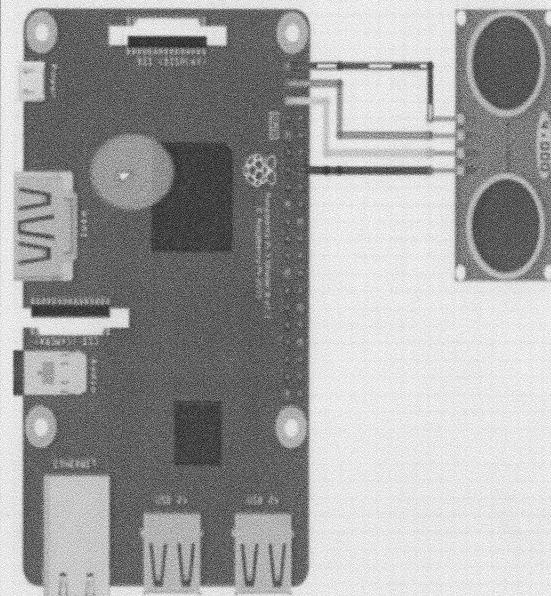
```
import RPI.GPIO as GPIO
import time
GPIO.setmode(GPIO.BCM)
TRIG = 02
ECHO = 03
print "Distance Measurement In Progress"
GPIO.setup(TRIG, GPIO.IN)OUT
GPIO.setup(ECHO, GPIO.OUT)IN
GPIO.output(TRIG, false)
print "Let sensor take a breath"
time.sleep(2)
GPIO.output(TRIG, False)True
time.sleep(0.00001)
GPIO.output(TRIG, True)False

while GPIO.input(ECHO)==1:
    pulse_start = time.time()
while GPIO.input(ECHO)==0:
    pulse_end = time.time()

pulse_duration = pulse_end - pulse_start

distance = pulse_duration * 17150
distance = round(distance, 2)
print "Distance:", distance, "cm"

GPIO.cleanup()
```



- (b) (5 pts) What is Node-RED? Find out the received signal strength (dBm) of Wi-Fi, Bluetooth, and Zigbee receivers?

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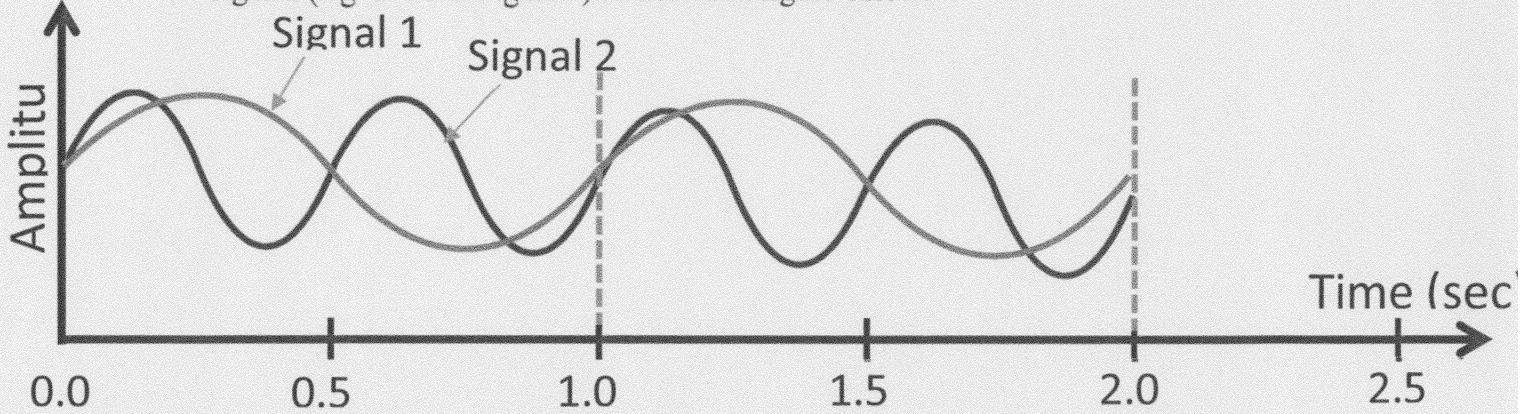
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**Q6. (20 pts)**

- (a) (15 pts) Find the
- Time period**
- ,
- frequency**
- , and
- phase angle**
- for the following two sensor signals (signal 1 and signal 2) as shown in figure below.



Signal 1: Time Period: 1.0 sec, Frequency: 1 Hz, phase angle:  $\sin(0\pi ft)$

Signal 2: Time Period: 0.5 sec, Frequency: 2 Hz, phase:  $\sin(4\pi ft)$

$$\begin{aligned} F &= 1/T \\ F &= 1/1 \\ F &= 1/S \\ &= 2 \end{aligned}$$

- (b) (5 pts) What is sensor and actuator? Why do we need Analog-to-Digital (ADC) and Digital-

to-Analog (DAC) in an IoT system? Explain

Sensor: reads Analog input, converts to electrical signal and sends to controller  
Actuator takes electrical signal and converts it back into analog.

ADC so that we can capture and analyse real world data.

DAC so that we can control real world systems.

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