ITY UNIVERSITY OF HONG KONG

Course code & title : GE1354 Introduction to Electronic Design

Session : Semester A 2020 / 2021

Date : Dec 11, 2020

Time : 2:00pm – 4:00pm (Two hours)

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1. This paper consists of 24 questions in 2 sections.
2. Section A consists of 20 multiple choice questions. Each question carries 2 marks.
3. Section B consists of 4 long questions. Each question carries 15 marks.
4. Answer<u>ALL</u> questions.

This is an**open-book**examination.

Materials, aids & instruments permitted to be used during examination:

1. Portable battery-operated calculator
2. Students are allowed to use course notes. However, NO communication with others is allowed during an examination.

Instructions for the Examination:

1. Please be warned if you do not submit the exam by 4:00pm, Canvas will automatically submit your answers and the exam will end.
2. Once you are ready to submit, click "submit quiz" and the exam will end for you. You have only ONE attempt.
3. There are 24 questions. Different questions may carry different marks and demand different forms of answers. Read the questions carefully. Attempt all questions to score the maximum mark.
4. All answers should be typed on Canvas.

5. During the exam, Zoom video will be used to show your face and your Student ID (on the course lecturer’ s request). You may ask questions during the exam through the Chat function of Zoom.

Yourcontinuedaccess to do this quizwillmean that you agreeto ourAcademic Honesty Pledge:

I pledge that the answers in this examination are my own and that I will not seek or obtain an unfair advantage in producing these answers. Specifically,

- I will not plagiarise (copy without citation) from any source;
- I will not communicate or attempt to communicate with any other person during the examination; neither will I give or attempt to give assistance to another student taking the examination; and
- I will use only approved devices (e.g., calculators) and/or approved device models.

I understand that any act of academic dishonesty can lead to disciplinary action.

Should you have any question during the examination, you can contact the Chief Invigilator via

1. Phone no.: (+852) 3442 7807, email:eeshc@um.cityu.edu.hk, WeChat: henryshchung
2. Department hotline: (+852) 3442 7740 (for students in HK)
3. Department WhatsApp phone: (+852) 9269 4066 (for students out of HK)
4. Department WeChat ID: wxid_lly7yf5fzoj722 or scan the following QR Code (for students out of HK only)

Note: this is a timed quiz. You may check the remaining time you have at any point while taking the quiz by pressing the keyboard combination SHIFT, ALT, and T... Again: SHIFT, ALT, and T...

Flag this Question

Question 10 pts

Please declare your geographic location.

Group of answer choices

Hong Kong

Mainland China

Overseas country

Flag this Question

Question 2 2 pts

Which of the following statement(s) is/are correct?

Group of answer choices

A signal conditioning circuit should have its bandwidth covering the frequency spectrum of the input signal.

An ideal filter should have high roll-off characteristics.

An ideal voltage source can deliver infinitive current.

The waveform of the output signal of an ideal signal conditioning circuit must be the same as the input signal.

Flag this Question

Question 3 2 pts

What is the phase difference between two AC voltage sources

$v_1(t) = 5\cos(5000\pi t)$ and $v_2(t) = 8\sin(5000\pi t + 30^o)$?

Group of answer choices

30 o

Undetermined

0 o

120 o

Flag this Question

Question 4 2 pts

If two AC voltage sources $v_1(t) = 5 \sin(2000\pi t + 90^o)$ and $v_2(t) = 8 \sin(5000\pi t + 30^o)$ connected in series, what is the fundamental frequency of the resultant voltage?

Group of answer choices

2.5kHz

1kHz

non-periodic

500Hz

Flag this Question

Question 5 2 pts

If the time sequence of the output voltage of a sensor is [10, 13, 12, 9, 11] and the actual voltage is 10V, what is the maximum percentage error if a moving window of two samples is applied:

Group of answer choices

25%

5%

10%

20%

Flag this Question

Question 6 2 pts

Amplifier 1 has roll off of -20dB/decade from 1kHz to 1MHz. Amplifier 2 has roll off of -40dB/decade from 10kHz to 1MHz. If the two amplifiers have the same gain at 1kHz, what is the ratio between the gains of Amplifier 1 and Amplifier 2 at 100kHz in dB?

Group of answer choices

- 40dB
- 20dB
- -40dB
- -20dB

Flag this Question

Question 7 2 pts

When the output load of an amplifier is changed from 200 Ω to 100 Ω, the amplifier output is changed from 12V to 8V. What is the output resistance of the amplifier?

Group of answer choices

- 200 Ω
- 10 Ω
- 66.67 Ω
- 100 Ω

Flag this Question

Question 8 2 pts

If two sinusoids, $v_1(t) = 2\sin(2000\pi t)$ and $v_2(t) = 4\cos(2000\pi t)$, are multiplied, what is the fundamental frequency of the output?

Group of answer choices

4kHz

1kHz

2kHz

DC only

Flag this Question

Question 9 2 pts

Which of the following statements is/are correct?

Group of answer choices

Ideal amplifiers have low noise immunity.

Electronic components generate shot noise.

Flicker noise is white.

Thermal noise is white.

Flag this Question

Question 10 2 pts

If the full-scale voltage of a 3-bit analog-to-digital converter is 5V, what is the maximum voltage difference between the outputs “010” and “100”?

Group of answer choices

2.5V

1.875V

1.25V

0.625V

Flag this Question

Question 11 2 pts

If the output of a sensor consists of DC, 1kHz, 10kHz, 20kHz, 50kHz, and 100kHz components, if the frequencies of interest include 50kHz, 100kHz, and above. Suggest a suitable filter type.

Group of answer choices

Band-stop filter

Low pass filter

Band pass filter

High pass filter

Flag this Question

Question 12 2 pts

Which of the following statement/statements is/are CORRECT?

Group of answer choices

Terahertz wave belongs to a transverse wave.

The wave generated by a microwave oven belongs to a mechanical wave.

Sound generated from a tuning folk belongs to a transverse wave.

Sound heard from a television belongs to a mechanical wave.

Flag this Question

Question 13 2 pts

Which of the following statement/statements is/are CORRECT?

Group of answer choices

The products of the frequency and the wavelength of a sound wave is constant.

The speed of sound in the liquid is inversely proportional to its frequency.

The velocity of sound traveling in a solid medium, in general, is faster than in a liquid medium or in a gaseous medium.

The velocity of sound in vacuum is slower than in gaseous medium.

Flag this Question

Question 14 2 pts

A car horn generating a tone f_s = 800Hz moves away from a stationary observer at a speed of v_s =15 m/s. What is the frequency f_0 (Hz) being heard by the observer? You may assume the velocity of sound in air is v_a = 340 m/s.

Group of answer choices

766.2 Hz

835.3 Hz

836.9 Hz

764.7 Hz

Flag this Question

Question 15 2 pts

Which of the following statement/statements about a MicroBit board is/are CORRECT?

Group of answer choices

Measure its surrounding temperature.

Generate a PWM signal using any one of its I/O pin

Detect the fall motion of an object.

Being programmed by either python language or MakeCode only.

Flag this Question

Question 16 2 pts

In the python language, the command “button_a.is_pressed()” belongs to which type of the programming structures?

Group of answer choices

None of them

Selection

Iteration

Sequence

Flag this Question

Question 17 2 pts

What is the beat frequency f_B produced by the superposition of 3.5 kHz and 2.8 kHz sound waves with the same amplitude?

Group of answer choices

1.3kHz

9.8 kHz

6.3 kHz

0.7 kHz

Flag this Question

Question 18 2 pts

If the third harmonic of a sound wave is 150 Hz, what is its fourth harmonic frequency f_4?

Group of answer choices

100 Hz

200 Hz

150 Hz

50 Hz

Flag this Question

Question 19 2 pts

Which of the following is the basic principle of Sonic Bomb?

Group of answer choices

Doppler Effect

Superposition

Frequency Beating

Binaural Beat

Flag this Question

Question 20 2 pts

Calculate the acoustic power P transmitted through a cross-sectional area of 0.1 m^2 if its sound intensity is 60dB above a reference power of 10^{-10} W/m^2.

Group of answer choices

10 mW

1 mW

100 mW

0.1 mW

Flag this Question

Question 21 2 pts

If the frequency of a musical note A is 109.00 Hz, what is the frequency of musical note C?

Group of answer choices

130.82 Hz

138.60 Hz

137.33 Hz

129.62 Hz

Flag this Question

Question 22 15 pts

Fig. Q1 shows a battery charging circuit. The microprocessor firstly samples the voltage across a variable resistor *R*, then calculates the battery current i_B and finally adjusts the value of *R* to regulate i_B.

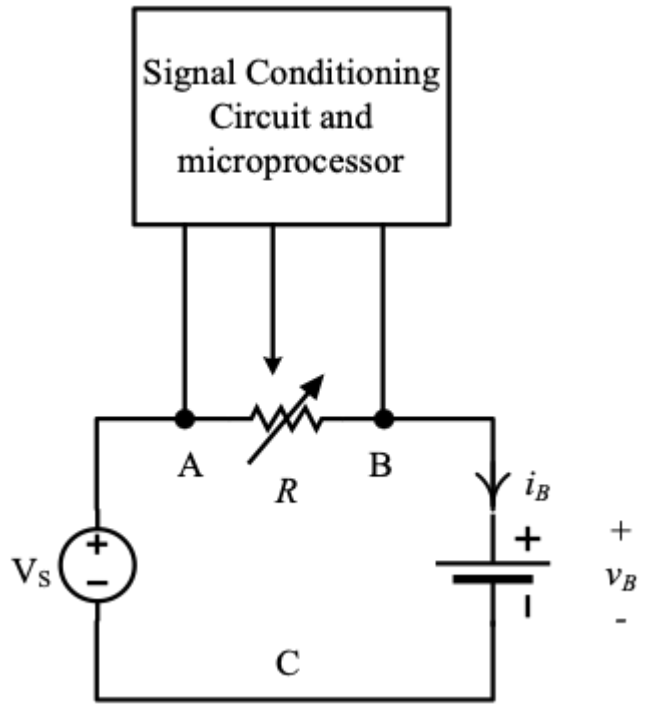

Fig. Q1 Battery Charging Circuit

(a) Express i_B in terms of V_S, *R*, and v_B. (2 mark)

(b) Explain why the voltage across *R* is sampled. (2 mark)

(c) What is the power loss of the circuit in terms of V_B, V_S, and i_B? (2 mark)

(d) What is the impact if the input resistance of the signal conditioning circuit is small? (2 mark)

(e) Should the grounding of the signal conditioning circuit be connected to node “A” or “B”? Why? (2 marks)

(f) If you are asked to sample V_S, v_B, and voltage across *R*, suggest how the ground of the microprocessor board is connected to the circuit and any modification on the number of sensing pins is required. (2 marks)

(g) Discuss the current regulation mechanism over the charging process. (3 marks)

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Paragraph
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44 words

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Question 23 15 pts

Consider a 10-bit analog-to-digital converter (ADC) with full-scale voltage is 10V. The ADC is used to sample AC line voltage with peak value of 311V and frequency of 50Hz. It is also necessary to sample frequency components up to 40^{th} order. A signal conditioning circuit is used to condition the AC line voltage before connecting to the ADC.

(a) Discuss the AC gain, frequency response, and input resistance of the signal conditioning circuit. (6 marks)

(b) Determine the AC gain and bandwidth required. (2 marks)

(c) If the conversion time of the ADC is 100 μ s, what is the maximum sampling frequency? (1 mark)

(d) Suggest the maximum conversion time of the ADC so that the signal can be recovered. (1 mark)

(e) If the sampled value is “1FF”, what is the actual AC voltage? (2 mark)

(f) If the sampled value has variation of one bit, discuss the uncertainty in measuring the AC voltage. (3 marks)

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12pt

Paragraph

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48 words

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Question 24 15 pts

The following function controls the ultrasonic module, as shown in Fig. Q3, by a MicroBit board. The codes are the python codes developed on mu python code editor.

```
1    def func2():
2        pin12.write_digital(1)
3        sleep_us(10)
4        pin12.write_digital(0)
5        data_C = time_pulse_us(pin2,1)
6        data_D = 160*data_C
7        return value_D
```

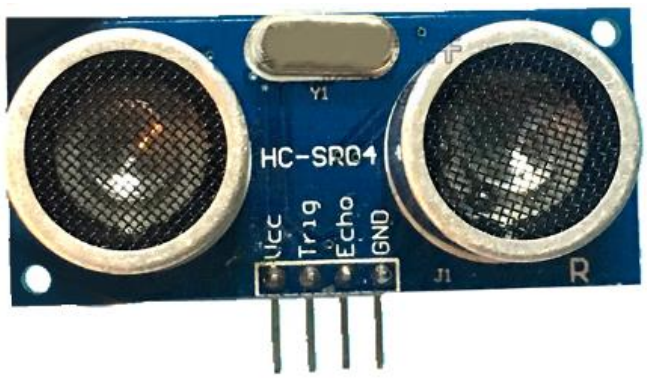

Fig. Q3 Ultrasonic Sensor Module

Please answer the following questions:

(a) What is the function of the ultrasonic sensor module? (1 mark)

(b) What is the function of the pin “Echo”? (2 marks)

(c) Which pins on the MicroBit should be connected to the pins “Trig” and “Echo” of the module? (2 marks)

(d) If the return value of the variable data_C is 1500, calculate the value of the variable data_D. What is the physical meaning of data_D? Give a dimension for data_D in your answer. (4 marks)

(e) Write a main program to call this function and display the return value on the 5x5 LED display with the unit. You should also include all the python commands required to initialize the main program and function func2. (6 marks)

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Paragraph
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span
102 words

Flag this Question

Question 25 15 pts

The following function is part of a python program developed on mu python code editor for MicroBit.

```
1   def func1(data_A):
2       data_B = 0
3       for i in data_A:
4           data_B += i
5       if len(data_A) > 0:
6           return data_B/len(data_A)
7       else:
```

```
8                   return None
```

Please answer the following questions:

(a) What is the function of func1? Describe its logic flow briefly. (3 marks)

(b) What is the purpose of using the python command “len() in line 6? (1 mark)

(c) If the variable data_A has eight numbers (1, 3, 5, 7, 10, 25, 20, 35), calculate the return values of the function func1. (3 marks)

(d) What happens if we skip line 5, 7, and 8? (3 marks)

(e) Write a main program to call this function for calculating the value in (3), and display the return value on the mu python editor. The display format should include the following text “The answer is” before your answer. You should also have all the python commands required to initialize the main program and function func1. (5 marks)

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12pt

Paragraph