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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2019/2020**

**COURSE NAME** : ADVANCED MICROCONTROLLER  
**COURSE CODE** : BEC 41103  
**PROGRAMME CODE** : BEJ  
**EXAMINATION DATE** : DECEMBER 2019 / JANUARY 2020  
**DURATION** : 3 HOURS  
**INSTRUCTION** : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES.

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**Q1** (a) ARM Cortex series offers a great choice and opportunity to use the best-bit core for wide range applications. Briefly explain **THREE (3)** main categories of ARM Cortex core. (3 marks)

(b) Analyze and recommend a suitable ARM Cortex Core for each of the following applications. Justify your recommendation.

- (i) Smartphone operates on Android environment.
- (ii) Automotive anti-lock braking system (ABS).
- (iii) Smart street light for a city.

(6 marks)

(c) **Figure Q1(c)** illustrates ARM7 programmers model. Analyze the figure and answer the following questions.

R0  
R1  
R2  
R3  
R4  
R5  
R6  
R7  
R8  
R9  
R10  
R11  
R12  
R13 (MSP)  
R14 (LR)  
PC  
PSR  
  
PRIMASK  
FAULTMASK\*  
BASEPRI\*  
CONTROL

**Figure Q1(c)**

(i) Explain the significance of special purpose registers R13, R14 and R15.

(5 marks)

(ii) Draw the structure of program status registers and explain its role in ARM Cortex.

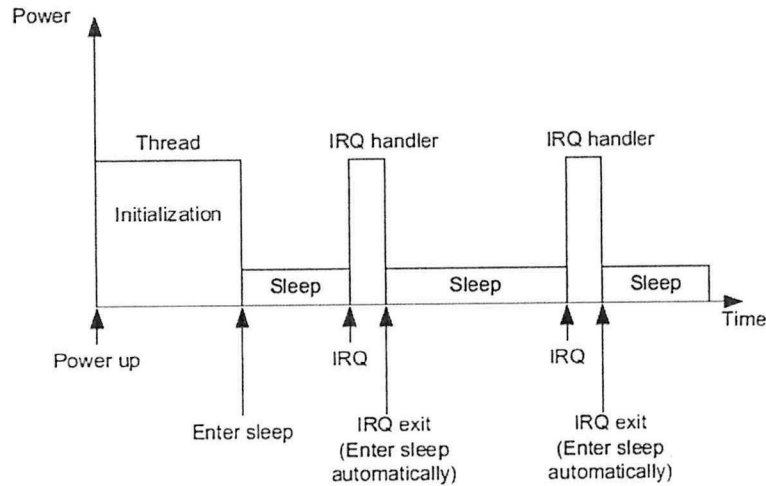
(6 marks)

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**Q2 (a)** Explain **THREE (3)** low-power features for ARM Cortex processor.

(6 marks)

(b) **Figure Q2(b)** shows the processor activities for an interrupt driven application. Examine the figure and answer the following questions.



**Figure Q2(b)**

(i) Identify the type of low-power feature based on timing diagram given in **Figure Q2(b)**. Justify your answer

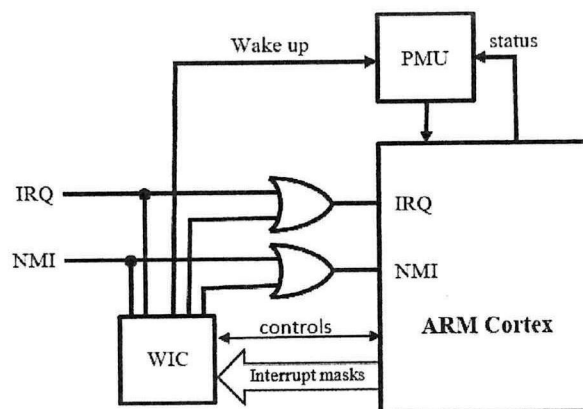
(2 marks)

(ii) Explain the impact of sleep mode for the application.

(4 marks)

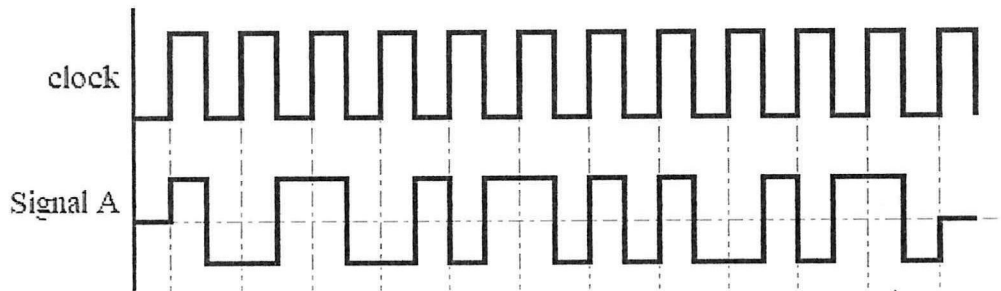
(c) Wakeup Interrupt Controller (WIC) as shown in **Figure Q2(c)** is a small interrupt detection logic that allows the power consumption of the processor to be further reduced by stopping all the clock signals to the processor. Describe the process to activate WIC deep sleep mode operation and handle the interrupt detection operation.

(8 marks)



**Figure Q2(c)**

- Q3** (a) Compare the differences between local area network (LAN) and wide area network (WAN). (5 marks)
- (b) Define Manchester encoding. (3 marks)
- (c) Given a timing diagram in **Figure Q3(c)**. Determine Manchester encoding for Signal A. (12 marks)



**Figure Q3(c)**

- Q4** Controller Area Network (CAN) is a serial communications protocol that was developed to allow a number of electronic units on a single vehicle to share essential control data. The CAN interface in mbed is used for transferring data between two mbeds microcontroller.
- (a) Explain whether it is possible to establish a direct communication between CAN controllers over two mbeds. Justify your answer. (3 marks)
- (b) Draw a schematic circuit for a communication between CAN controllers over two mbeds. (8 marks)
- (c) Write a C code for sending an incrementing count value to the CAN bus every second. (9 marks)

**Q5 (a)** Differentiate between a finite impulse response (FIR) and an infinite impulse response (IIR) digital filter.

(3 marks)

(b) Figure Q5(b(i)) illustrates schematic circuit of an audio DSP system that is implemented using mbed microcontroller to receive a 1000 Hz input audio signal. Figure Q5(b(ii)) shows the input audio signal (smooth line) for the audio DSP system and its output signal (discrete step).

(i) Explain why the output signal is not a smooth output.

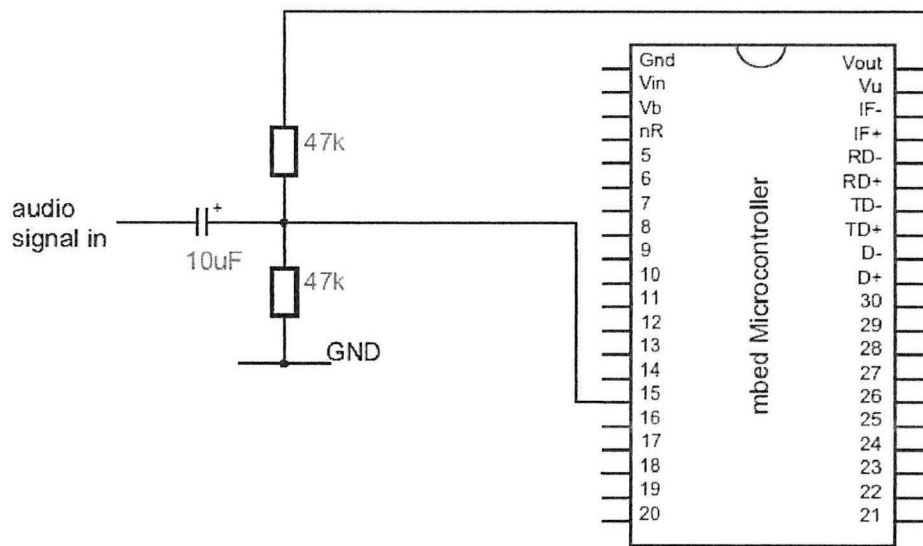
(1 mark)

(ii) Propose a method to remove all steps of DAC output signal. Justify your recommendation.

(3 marks)

(iii) Sketch the schematic circuit for the solution as proposed in Q5(b)(ii).

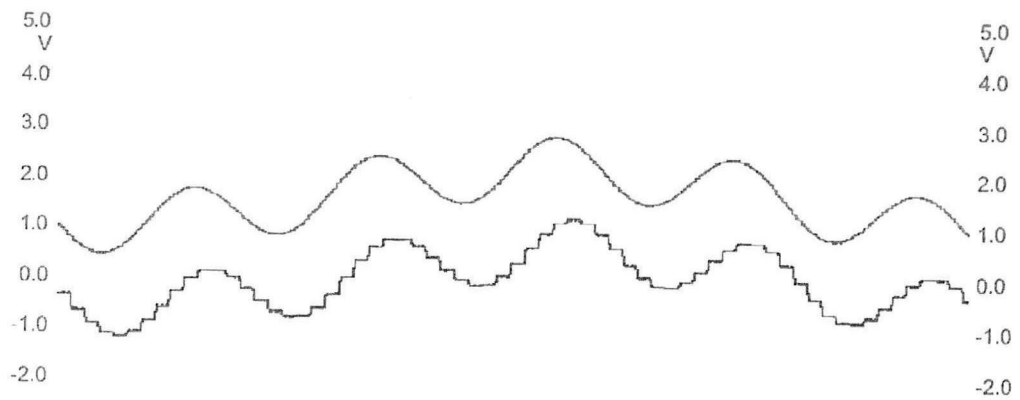
(2 marks)



**Figure Q5(b)(i)**

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**Figure Q5(b)(ii)**

- (c) A live audio processing would like to create an echo effect for a guitar. Recommend a method to make an echo effect. By providing a suitable block diagram, explain your recommendation method.

(11 marks)

**- END OF QUESTIONS -**

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