

SECTION A**MULTIPLE CHOICE QUESTIONS [3 marks each]**

1. Please write your answers in the answer booklet.
 2. No marks will be deducted for incorrect answers.
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- A1. There is a drive to deploy much more embedded systems with low power consumption in different kinds of applications. Which one of the following is *not* a contributing factor?
- (a) Global warming.
 - (b) The great increase in embedded computing power.
 - (c) Natural resources getting more scarce.
 - (d) Greater number of networks being set up. (3 marks)
- A2. In many situations, a 9V battery is used with a 7805 type regulator to power a 5V circuit which draws 20 mA. By how many times would power would be saved if we now use a LDO regulator with 5.5V supplied by a (roughly) 100% efficient SMPS?
- (a) 8 (4/0.5).
 - (b) 80 (80/1).
 - (c) 175 (3.5/0.02).
 - (d) 640 (80/2)^2. (3 marks)
- A3. What does the term "104" in the PC/104 architecture refer to?
- (a) It is the maximum number of I/O devices that can be supported.
 - (b) For the address bus of 10 bits and 4 control signals.
 - (c) The number of pins used.
 - (d) Initial documentaion had 104 pages. (3 marks)
- A4. For popular single board computers like the Arduino and Raspberry Pi which have ports for interfacing, which one of the following is *not* a reason to connect external buffers?
- (a) When there is more current needed.
 - (b) In experimental conditions, to untested peripherals.
 - (c) There is a need to connect multiple 8 bit devices.
 - (d) When a higher voltage is needed. (3 marks)
- A5. What is an advantage of using a flash memory *chip* as compared to a flash memory *device*?
- (a) Easy to interface to workstations.
 - (b) Data can be easily transferred through files.
 - (c) Small size.
 - (d) Physically, they can be handled easily. (3 marks)

A6. A latch is connected to the 2nd (Y2) output of a 74138 using the decoding scheme described in the lecture notes. Which one of the following addresses (hex) can be used to access it?

- (a) 388₁₆
- (b) 386₁₆
- (c) 384₁₆
- (d) 382₁₆

(3 marks)

A7. Which one of the following is not a problem faced when interfacing to a keypad?

- (a) N-key lockout.
- (b) Keyboard bounce.
- (c) Phantom key.
- (d) Multiple keys pressed at once.

(3 marks)

A8. Separatists in Catalonia, Spain, are considering using the peseta for their commerce. For their point of sale devices, the symbol is ₧ which is not available in current LCDs. What is the lowest cost option?

- (a) Use a program to store it in DDRAM when power comes on.
- (b) Construct this character and store it in CGRAM upon power up.
- (c) Get a manufacturer to build an LCD that has this symbol.
- (d) Look for a special LCD that has this symbol.

(3 marks)

A9. When choosing a processor to use which one of the following is *not* a consideration?

- (a) Popularity of use.
- (b) Speed of processing.
- (c) Ready to use software available.
- (d) Cost per unit.

(3 marks)

A10. Which one of the following is true about the interaction diagram used in UML?

- (a) They are developed from the user manual.
- (b) Time delays are shown by circles.
- (c) Like a flowchart, it only shows the transfer of logic control.
- (d) Shows the relation between time and subsystems.

(3 marks)

Section B

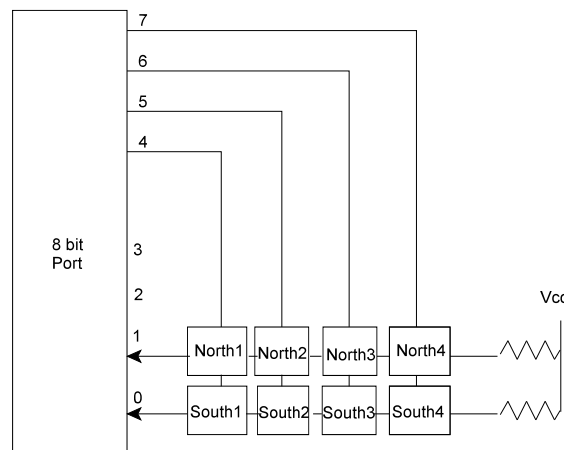
- B1. (a) What are the four ways processors increase in performance? (4 marks)
- (b) Briefly describe two major changes for a program to work in a low power consumption embedded system. (6 marks)
- (c) Give two examples of human characteristics, that IoT devices can tell from interaction with it. (2 marks)

- B2. In an image based water detection system, a camera will capture images at high speed for subsequent analysis. Based on the analyses, certain images will be saved as proof of the presence of water. A history of the computations-which occupy little space- are also kept.

In this part of the design, describe the use of suitable memory types as shown below and the reason for its use, in a table format.

- (a) ROM. (4 marks)
- (b) RAM. (3 marks)
- (c) Flash memory (3 marks)
- (d) Serial EEPROM. (3 marks)

- B3. A water detection system in a tunnel uses sensors that close a contact when water is present above a certain threshold. For the proposed sensor layout, assume unused pins are at logic 1. They are to be placed on the North and South entrances.



- (a) For the above sensor layout, create a table of scancodes to detect the sensors. (8 marks)
- (b) If this layout were extended to 90 sensors, show with working, what would be the best combination of buffers and latches to use? (4 marks)

B4. An embedded system needs 64K of memory to store images on power down and also be able to update them. It occupies the memory addresses starting from D0000H. Use only 16K devices in your design.

- (a) List the memory map. (4 marks)
- (b) Show the truth table. (4 marks)
- (c) Draw the schematic. (3 marks)

What is a suitable type of memory to use?

(Long question: 20marks)

B5. Mass transport systems generally run in underground tunnels to avoid traffic congestion. However there is a need to detect excessive rainwater and activate a drainage system automatically. One proposal is to use a water sensor mounted on a pole. At an interval of one minute, a motor moves the pole vertically to detect if a new water level is reached. A display will show the water level clearly.

The system must be waterproof and be powered from a large battery.

- i) What are the goals and constraints for the system design? (4 mks)
- ii) Identify the sub-systems required by the water detection system. (4 mks)
- iii) Draw a *use case* diagram for the above system: note carefully *what* initiates the actions taken by the processor. (4 mks)
- iv) Draw the sequential interaction diagram for the system *only* during the water level sampling phase. (6 mks)
- v) In this system, what type of display would you recommend to be used? (2 mks)

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