

2016/2017 SEMESTER ONE MID-SEMESTER TEST

Diploma in Electrical and Electronic Engineering
3rd Year Full-Time

EMBEDDED COMPUTER SYSTEMS

Time Allowed: 1½ Hours

Instructions to Candidates

1. The Singapore Polytechnic examination rules are to be complied with.
2. This paper consists of **THREE** sections :

| | |
|--|-----------|
| Section A-10 Multiple Choice (3 marks each) | 30 marks |
| Section B-4 Short Questions (12,13 marks each) | 50 marks |
| and 1 Long Question (20 marks) | 20 marks |
| Total | 100 marks |
3. **ALL** questions are **COMPULSORY**.
4. All questions are to be answered in the answer booklet. Start each question on a new page.
- 5 This paper consists of **6** pages.

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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1. An embedded system is to be used in a battery powered remote control device which uses a keypad. Which aspect of embedded system design should you be concerned with?
 - (a) Power consumption.
 - (b) Reliability.
 - (c) Single Use.
 - (d) Guaranteed response time.
 2. As compared to standard programs using interrupts, what is a difference when programming for low power design?
 - (a) None, no change is necessary.
 - (b) The main program loop now consists of going into low power modes.
 - (c) There is no longer a need for real time performance.
 - (d) There is no need to use global variables.
 3. The "104" in the specification of the PC/104 bus refers to the:
 - (a) speed of the bus which is 104 Mhz.
 - (b) dimensions of the connector which is 10 cm by 4 cm.
 - (c) number of electrical pin connections used.
 - (d) physical layout of 10 pin single row connectors for which there are 4 of them.
 4. In comparing the use of main *program* memory for embedded computer systems (ECS) and general purpose computing systems (GPCS), which one of the following is *not* true?
 - (a) ECS use flash EEPROM because they do not change their main function.
 - (b) GPCS use RAM because they operate faster.
 - (c) ECS use flash EEPROM as all software needed will not be erased when turned off..
 - (d) GPCS use RAM because they can change their main function frequently.
 5. When interacting with humans, suitable devices for input and output are respectively:
 - (a) latches and latches.
 - (b) latches and buffers.
 - (c) buffers and latches.
 - (d) buffers and buffers.

6. What is the difference between I/O and memory addressing on a PC/104 bus?
- (a) The width of the data bus, being 8 bit and 16 bit respectively.
 - (b) One uses the control bus, the other does not.
 - (c) I/O data transfer is always faster.
 - (d) The use of 16 and 20 bit addressing, respectively.
7. An external memory device does *not need* an extra OR gate when interfacing to the PC/104 bus as compared to buffers or latches. This is because
- (a) it will reduce the fanout on the PC/104 bus.
 - (b) the decoding circuit has enough signals to select the chip.
 - (c) they have separate read and write inputs.
 - (d) they operate at higher speeds.
8. Which one of the following is *not* true about interrupt driven keypads?
- (a) The software involved will be slightly more complex.
 - (b) It will take a longer time to respond to a keypress.
 - (c) Hardware will be more complicated
 - (d) There will a large reduction in electrical power used.
9. When considering product requirements which one of the following is *not* a constraint?
- (a) A product needs to boil an egg for a given time interval.
 - (b) The cost of the product must not exceed a given amount.
 - (c) The product must have its power source when in operation.
 - (d) Product must be waterproof.
10. When a design moves from prototype to production stage, what is *not* a suitable activity?
- (a) Design easy diagnostic tools.
 - (b) Devise comprehensive product test procedures.
 - (c) Redesign product to lower assembly costs.
 - (d) Ensure the design parameters are consistent among its sub-components.

Section B

B1. a) In what ways do computing power increase in embedded computers increase? (6 mks)

b) What are three considerations to take note of when considering the supply of power for self-powered embedded systems? (6 mks)

B2. A medication delivery system allows a user to record customized messages and also to play back the messages at given intervals for reminders to take the medication.

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

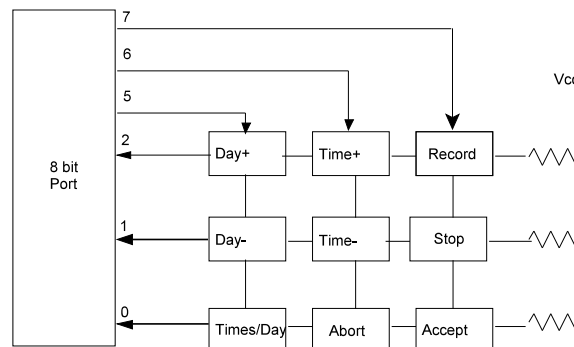
(a) ROM. (4 marks)

(b) RAM. (3 marks)

(c) Flash memory (3 marks)

(d) Serial EEPROM. (3 marks)

B3.



A medication delivery system uses a keypad for users to customize the system. For the proposed keypad layout, assume unused pins are at logic 1.

(a) Create a table of scancodes for the above keypad. (9 marks)

(b) Briefly explain if it is possible for the phantom key effect to occur in this setup? (3 marks)

B4. An embedded system needs 32K of memory and occupies the memory addresses starting from E4000H. Use 8k devices in your design.

- (a) List the memory map. (4 marks)
- (b) Show the truth table. (4 marks)
- (c) Draw the schematic. (5 marks)

(Long question: 20marks)

B5. A medication delivery system is proposed to help the aged take their medication. A circular tray with seven compartments will hold the medicine for the week.

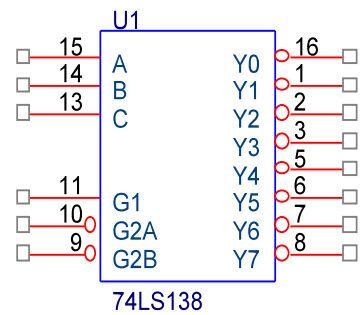
At given time intervals, a synthesized voice will remind the user to take their medication. The user presses a button which causes the tray to rotate to the correct position. After that a non-electronic mechanism opens the compartment (so it does not have to be controlled by the processor). Finally a message will be displayed.

The system must be capable of rough use and be easily operated.

- (a) What are the goals and constraints for the system design? (5 marks)
- (b) Identify the sub-systems required by the medication delivery system. (4 marks)
- (c) Draw a *use case* diagram for the above system when the user activates the system to dispense the medicine. (3 marks)
- (d) Draw a sequential interaction diagram for the system for when the user activates the mechanism after being reminded. Note: Not all the subsystems in b) are used. (6 marks)
- (e) Should the system automatically rotate the tray and open the compartment at the same time without user intervention? (2 marks)

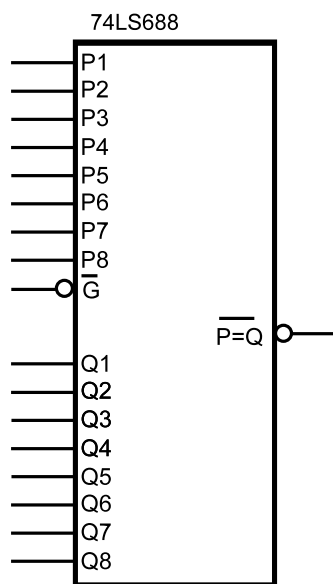
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Truth table



74LS138 schematic

| INPUTS | | | | | | OUTPUTS | | | | | | | |
|--------|-----|----|--------|---|---|---------|----|----|----|----|----|----|----|
| ENABLE | | | SELECT | | | | | | | | | | |
| G2B | G2A | G1 | C | B | A | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
| X | X | L | X | X | X | H | H | H | H | H | H | H | H |
| X | H | X | X | X | X | H | H | H | H | H | H | H | H |
| H | X | X | X | X | X | H | H | H | H | H | H | H | H |
| L | L | H | L | L | L | L | H | H | H | H | H | H | H |
| L | L | H | L | L | H | H | L | H | H | H | H | H | H |
| L | L | H | L | H | L | H | H | L | H | H | H | H | H |
| L | L | H | L | H | H | H | H | H | L | H | H | H | H |
| L | L | H | H | L | L | H | H | H | H | L | H | H | H |
| L | L | H | H | L | H | H | H | H | H | H | L | H | H |
| L | L | H | H | H | L | H | H | H | H | H | H | L | H |
| L | L | H | H | H | H | H | H | H | H | H | H | H | L |



74LS688 schematic

| Inputs | | $\overline{P=Q}$ |
|--------|--------------------------|------------------|
| Data | Enable \overline{G} | |
| P, Q | | |
| P = Q | L | L |
| P > Q | L | H |
| P < Q | L | H |
| X | H | H |