UNIVERSITI SAINS MALAYSIA

Semester I Examination
Academic Session 2004/2005

October 2004

EEE 520 – EMBEDDED MICROPROCESSOR SYSTEM

Time : 3 hours

INSTRUCTION TO CANDIDATE:

Please ensure that this examination paper contains **SEVEN (7)** printed pages and **SIX (6)** questions before answering.

Answer **FIVE (5)** questions.

Distribution of marks for each question is given accordingly.

All questions must be answered in English.

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1. (a) Define the following terms (with three examples each) for the design of an embedded microprocessor system.

(i) Design Goals

(ii) Design Metrics

(30%)

(b) Assume that the output of the DAC in Figure 1b(i) is connected to the op- amp of Figure 1b(ii).

(i) With V_{REF} = 5V, R = 20 kΩ, and R_F = 10 kΩ, determine the step size and the full-scale voltage at V_{OUT}.

(ii) Change the value of R_F so that the full-scale voltage at V_{OUT} is -2.5 V.

(iii) Use this new value of R_F, and determine the proportionality factor, K, in the relationship $V_{OUT} = K(V_{REF} \times B)$.

(30%)

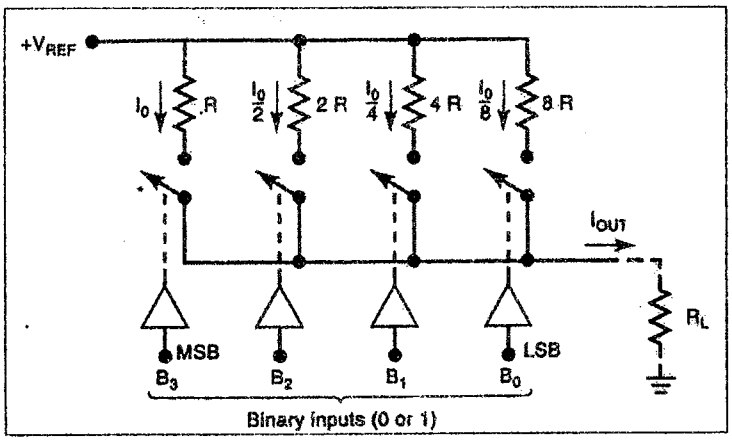

Figure 1b(i)

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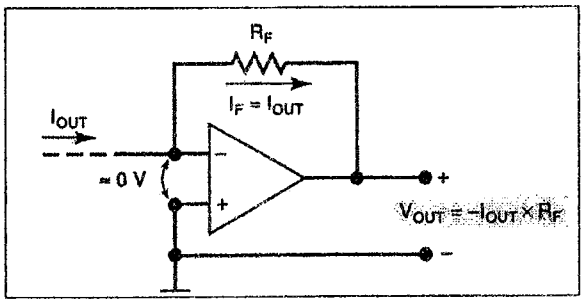


Figure 1b(ii)

(c) An eight bit digital-ramp ADC with 40 mV resolution uses a clock frequency of 2.5 MHz and a comparator with $V_T = 1mV$. Determine the following values.

(i) The digital output for $V_A = 6.000$ V

(ii) The digital output for 6.035 V

(iii) The maximum and average conversion times for this ADC.

(40%)

2. (a) Draw the timing diagrams of an SRAM memory module by describing the read and write operation.

(40%)

(b) Figure 2b shows a simple circuit for manually programming a 2732 EPROM. Each EPROM data pin is connected to a switch that can be set as a 1 or a 0 level. The address inputs are driven by a 12-bit counter. The 50-ms programming pulse comes from a one-shot each time the PROGRAM push button is actuated.

(i) Explain how this circuit can be used to program the EPROM memory locations sequentially with the desired data.

(20%)

(ii) Show how 74293s and a 74121 can be used to implement this circuit.

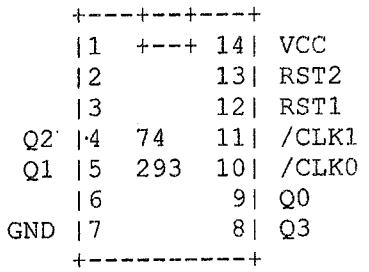
(30%)

(iii) Should switch bounce have any effect on the circuit operation?

(10%)

IC: 74293

4-bit asynchronous binary counter with /2 and /8 sections and reset.



IC: 74121

Monostable multivibrator with Schmitt-trigger inputs.

Programmable output pulse width from 40 ns to 20 seconds.

```
      +---+--+---+
  /Q  |1  +--+ 14| VCC
      |2       13|
/TR1  |3   74  12|
/TR2  |4  121  11| RCext
  TR  |5       10| Cext
   Q  |6        9| Rint
 GND  |7        8|
      +----------+
```

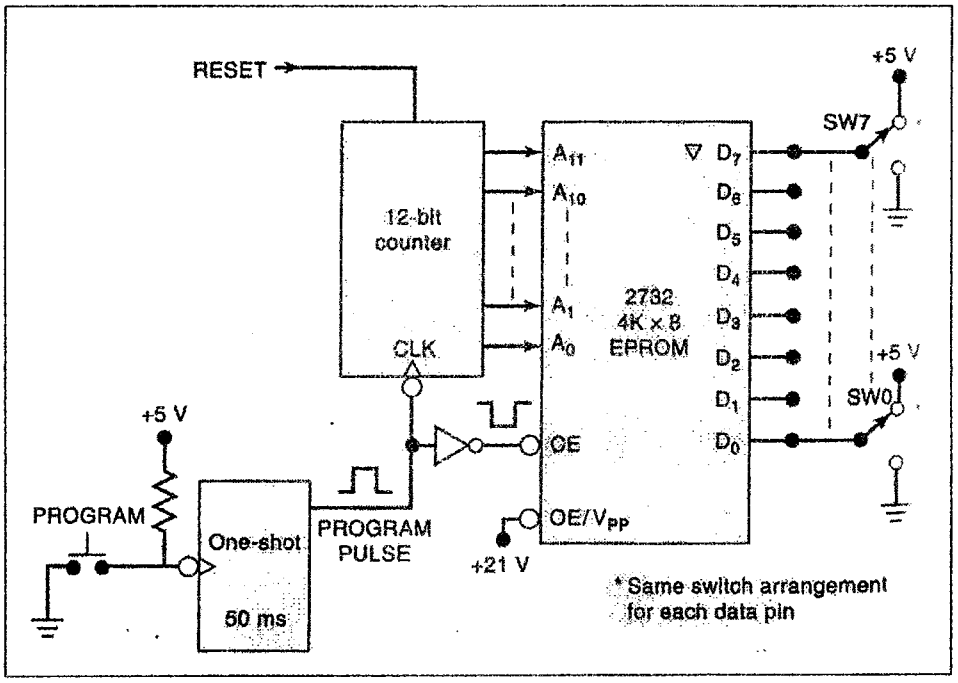


Figure 2(b)

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3. (a) The interrupt procedure executes the task required to service the external device. After the interrupt procedure completes execution, execution flow continues from the point of interruption. Explain in detail what is interrupt procedure? Your explanations must consists of the interrupt priority concepts, interrupt vectors, edge and level sensitive and interrupt latency.

(50%)

(b) You are designing a simple intrusion warning system that sounds a 400 Hz tone for 1 second whenever a door sensor is connected. It uses a microcontroller to read the sensor input and turn on the speaker in response to the connected door. Would you use interrupts for this application?

(50%)

4. (a) Explain the distinction between testing and debugging a program.

(25%)

(b) Explain the distinction between syntax error and logical errors. How is each type of these errors detected and located?

(25%)

(c) Tools for debugging embedded systems range from software monitors and simulators. Several tools combine these approaches and vary greatly in cost and performance. State and explain in detail the debugging tools that are commonly used to debug any embedded systems.

(50%)

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5. (a) Describe and explain the following methods for describing software design for microprocessor embedded design

(i) Data Flow Diagram
(ii) State Diagram
(iii) Flowcharts
(iv) Pseudo code

(60%)

(b) Discuss the advantages and disadvantages of the methods used to describe software design

(40%)

6. (a) List and elaborate two (2) mechanisms of communication between two microprocessors.

(30%)

(b) Explain the following 2 basic RTOS kernel services:

(i) Task management.
(ii) Dynamic memory allocation.

(50%)

(c) List the other 3 Basic Services excluding in 6(b) above provided by Real Time Operating System (RTOS).

(20%)

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