Revision Exercise

This document contains a few practice questions to help your revision. No solution is provided but discussions are welcome on the message board.

Question 1

Discuss and explain whether ARM Cortex-M microprocessor is Von Neumann machine or not. (Hint: there is no absolute answer – try to explain the similarity or difference with reasons)

Question 2

Study the following C program snippet:

```
int main(void){
    int x = 1;
    const int n = 5;

    for (int i = 2; i <= n; i++)
        x = x * i;

    …
}
```

Translate the C program into ARM assembly code. You should try to use minimise the number of registers and the amount of memory used in your translation.

Question 3

Discuss the main differences between general purpose timer and low-power time in ARM M3/M4 microprocessors.

Question 4

Discuss how the inclusion of clock stretching in I^2C affects the design of master and slave devices? Explain in both hardware and software aspect.

Question 5

What is the necessity of Priority Mask Register in Cortex-M4 microprocessor? Provide example of an application using the PRIMASK register.

Question 6

Using GPIO ports of an STM32F401 MCU, design a system that takes as input the position of a pressed switch connected to a pin X of GPIO_A (X between 0 and 15 – only one switch can be pressed at a given time). The LED connected to pin X of GPIO_B will be lit and when the control switch is activated, the LEDs connected to GPIO_B will start toggling until pin X is lit again. For example if X=3, once the control switch is activated LED_3 is ON, then LED_4 is ON and LED_3 is OFF at the same time, then LED_5 is ON and LED_4 is off,…then LED_15 is ON and LED_14 is off, then LED_0 is ON and LED_15 is OFF, ..then LED_3 is ON and LED_2 is OFF.
Provide a diagram that describes your system and the C code of the main function. You can use the functions gpio_get(), gpio_set() and gpio_set_mode() from the lecture notes in your answer. PLEASE CITE ANY REFERENCE THAT YOU USE, for example, cite: "lecture notes JPESD_08-GPIO slide 28" if you decide to use gpio_set() function.

Question 7

Two devices A and B use RS232 connection to communicate but each is operated by a different ARM microprocessors (STM32F401 family).
Device A's microprocessor:

- Main Clock: 8 MHz
- Supports only 8 data bit sizes
- Support single oversampling rate x16
- Supports both odd and even parity check
- Always uses 1 stop bit

Device B's microprocessor:

- Main Clock: 60 MHz
- Supports both 8 and 9 data bit sizes
- Support two oversampling rates x8 and x16
- Supports both odd and even parity check
- Supports 1 or 2 stop bits

Is it possible for these two devices to communicate?
What would be the fastest and slowest baud rate possible?
What would be the USART_BRR setting in each case for each device?