UNIVERSITY OF PERADENIYA

Faculty of Engineering

MID-SEMESTER TUTORIAL - MARCH 2018

CO321 – EMBEDDED SYSTEMS

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1) Which of the following is not considered as a common characteristic of an embedded system?
    a) Monotonous task
    b) Rigid design metrics
    c) General Purpose
    d) Real Time

2) Embedded systems involve many sub-disciplines of Engineering. Identify the most relevant knowledge area required by an Engineer designing a "remotely controlled automatic crop harvesting tool".
    a) Remote automation
    b) Automation
    c) Communication
    d) Industrial Control

3) Select the answer which is not a design metric of embedded system design.
    a) Maintainability
    b) Flexibility
    c) Functionality
    d) Performance

4) Most microcontrollers have on-chip EEPROMs to:
    a) Save power
    b) Reduce chip area
    c) Retain data
    d) Minimize production cost

5) What is the purpose of a crystal oscillator when used with a microcontroller?
    a) Providing the clock signal
    b) Connecting the microcontroller to the computer
    c) Stabilizing the input power
    d) None of the above

6) Which of the following statements is incorrect?
   a) Microcontrollers can be programmed using assembly language
   b) A compiled program, as a hex-file, is uploaded to the SRAM of the microcontroller
   c) A cross-compiler is required to compile programs for microcontrollers
   d) Microcontrollers contain a pre-selected set of peripherals

7) Bit manipulation programming is commonly used in microcontrollers because:
   a) The data processing is done at bit level
   b) Most microcontrollers use serial communication ports
   c) Signals need to be handled individually
   d) Microcontrollers use small number of bits for instruction encoding

8) In a microcontroller, there are typically three different registers associated with any given I/O port. Select the suitable justification for having such an architecture.
   a) For the prevention data loss during the absence of power
   b) To be able to correct errors in incoming data
   c) For directing, transmitting and receiving data
   d) To be able to connect three different external devices in parallel

9) In an 8-bit AVR microcontroller, the data direction of an I/O pin is defined by writing logic '1' for output and logic '0' for input at the corresponding bit position in a data direction register. You are asked to configure the first 4 pins of Port B as inputs and last 4 bits of Port B as outputs. Select the correct line of code for setting the data direction.
   a) `DDRB = 0xF0`
   b) `PORTB = 0xF0`
   c) `DDRB |= 0xF0`
   d) `PORTB |= 0xF0`

10) The following code snippet tries to copy the value in Port B to Port D, in an 8-bit AVR microcontroller. However, there is an error in this code. What is the error?

```
int main(){
    DDRB = 0;
    DDRD = 255;
    unsigned char temp;
    temp = PORTB;
    PORTD = temp;
}
```

   a) "`DDRD = 255`" should be "`DDRD = 0xFF`"
   b) "`unsigned char temp`" should be "`char temp`"
   c) "`PORTD = temp`" should be "`PIND = temp`"
   d) "`temp = PORTB`" should be "`temp = PINB`"

11) You are given the two circuit configurations below, to connect a switch to a general-purpose I/O pin in a microcontroller. Which of the following is the correct statement regarding the two circuits?
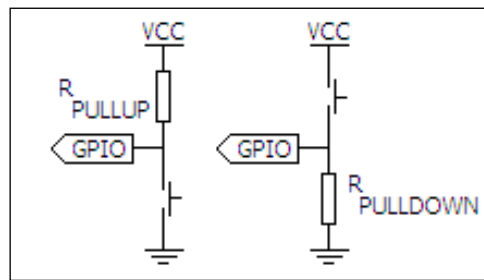

    a) Only the circuit with the pull-up resistor is correct
    b) Only the circuit with the pull-down resistor is correct
    c) Both circuits are correct
    d) A pull up/pull down resistor is not mandatory when connecting a switch

12) A processor does an automatic procedure call when:
    a) Executing each instruction
    b) An interrupt occurs
    c) Input data arrives at the port pin
    d) At the end of program execution

13) An interrupt vector table contains:
    a) Addresses or pointers for interrupt service routines
    b) Interrupt service routines for possible devices
    c) Part of interrupt service routine address
    d) A constant vector value for all interrupt routine address computation

14) When using external interrupts, if the input pulse rate is higher than the system clock rate:
    a) More devices can be serviced
    b) Large interrupt handler programs may not be executable
    c) Interrupt requests could be missed by the microcontroller
    d) Performance will be high

15) A student wrote a program that increases a `count` variable by one, every time a push button connected to the microcontroller is pressed. However, it was observed that `count` increments several times when the button is pressed once. What could the possible cause for this issue?
    a) The student did not implement switch de-bouncing
    b) The student used polling method and increments the count when the level of the switch signal is high, rather than checking for the edge of the signal
    c) The pull-up/pull-down resistor for the switch is missing
    d) All of the above

16) The bit width of a timer counter register determines the largest time period it can measure without using software loops. What is the smallest sized timer that can be directly used to generate a delay of approximately 3 seconds, with an 8MHz crystal oscillator? Assume that the available pre-scaler values are `1`, `8`, `64`, `256` and `1024`.
    a) An 8-bit timer
    b) A 16-bit timer
    c) A 32-bit timer
    d) A 64-bit timer

17) What pre-scaler value should be used to generate a delay of approximately 16ms, using an 8-bit timer with a 16MHz crystal oscillator?
    a) 128
    b) 256
    c) 512
    d) 1024

18) The diagram below shows a Timer Control Register called `TCCR0A`, in an 8-bit microcontroller. You are required to set the bits `WGM01` and `WGM00` to logic '1'. Select the best method to do this.

7	6	5	4	3	2	1	0	
COM0A1	COM0A0	COM0B1	COM0B0	–	–	WGM01	WGM00	TCCR0A
R/W	R/W	R/W	R/W	R	R	R/W	R/W	
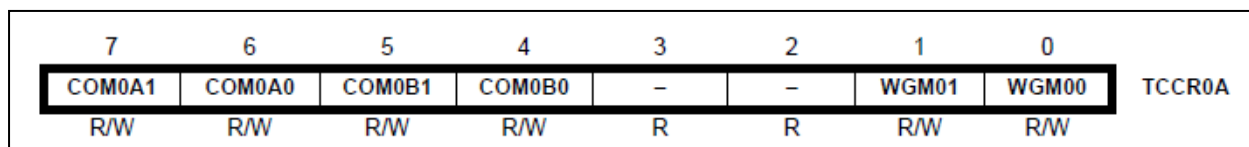
    a) `TCCR0A = 0x03`
    b) `TCCR0A |= 0x03`
    c) `TCCR0A &= ~0x03`
    d) `TCCR0A ^= 0x03`

19) In a microcontroller with 8-bit wide data bus, reading a 16-bit timer is accomplished by:
    a) Reading the lower byte first and the higher byte next from the timer register
    b) Reading the higher byte first and the lower byte next from the timer register
    c) Using a temporary register to preserve one byte while reading the other byte
    d) Cannot have a 16-bit timer in a microcontroller with 8-bit data bus

20) For a particular timer mode, an 8-bit timer wraps around at `0xFF` and restarts counting at `0x00`. A waveform can be generated based on interrupts generated as follows: output pin is set to high when Timer Counter = `0x00`; output pin is set to low when Timer Counter = Output Compare Register. What should you do to keep the signal always set to high?
    a) Load `0x00` to Output Compare Register
    b) Not possible to keep the signal always set to high
    c) Prevent timer from reaching `0xFF`
    d) Disable output compare match interrupt

21) What is <u>not</u> an application of Pulse Width Modulation (PWM)?
    a) Motor control
    b) Digital to analog conversion
    c) Analog to digital conversion
    d) Communication

22) In waveform generation, having an Output Compare Register in addition to a Timer Counter register allows to:
    a) Generate pulses with large time period
    b) Generate a high-frequency signal
    c) Pre-scale/post-scale clocks
    d) Change the low and high values of output signal at different instances of time

23) A microcontroller uses an 8-bit Timer Counter Register (TCNT) to generate a waveform through Pulse Width Modulation. At the beginning (when count = 0) output pin is set to logic '1'. When the counter value in TCNT reaches the value in Output Compare Register (OCR), the output pin is set to logic '0'. What value should be written to OCR to generate the following PWM signal?
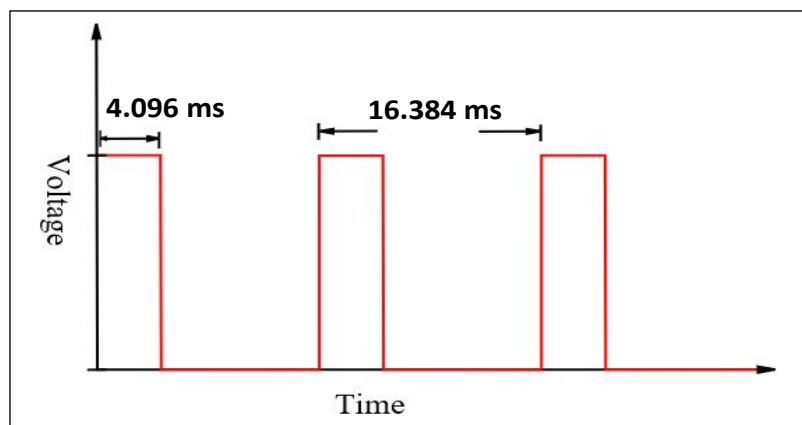
    a) 63
    b) 127
    c) 128
    d) 255

24) Refer to the description of the timer in question 23 to answer this question. Assume the clock is 1MHz. To produce a pulse with a pulse width of 90 microseconds:
    a) Timer should be loaded with value 90
    b) Timer should be loaded with value 89
    c) Output Compare Register should be loaded with value 90
    d) Output Compare Register should be loaded with value 89