

VE5103/ADVANCED EMBEDDED SYSTEM DESIGN

Unit IV – Assignment Questions

1. Specify the signaling format for START condition in I2C communication protocol?
2. Give the number of GPIO pins of microcontroller required for interfacing multiplexed seven-segment displays?
3. To display a character in LCD, the data sent to the LCD from CPU will be in _____ format.
4. To interface a 25-switch keypad with microcontroller. How many GPIO pins are required to interface the keypad with microcontroller in multiplexed format?
5. A steel plate connected to the shaft of stepper motor rotates at 10 rpm. It takes about 20 steps per second. Calculate the step angle of stepper motor?
6. A PWM signal of frequency 10 kHz and 5V amplitude is applied to the DC motor to control its speed. What should be the ON time of the PWM signal to achieve an average voltage of 1.25 V?
7. Let us assume a clock frequency of 20 MHz, a baud rate prescaler value of 4 and the CAN bit rate is 125 kHz. Calculate the CAN timing parameters?
8. Calculate the ON time of the PWM signal required to position the servo motor shaft at -60° . Assuming an ON time of $600 \mu\text{s}$ for -90° and ON time of $2400 \mu\text{s}$ for $+90^\circ$. The frequency of the PWM signal is maintained constant.
9. Upon reading a switch, we get '1' when the switch is pressed and '0' when the switch is not pressed. Mention the configuration of the resistor connected to the switch?
10. A BCD input of 0010 is given to BCD to Seven segment decoder, which segments of the Common Cathode Seven Segment Display would be active to display that number?
11. A bipolar stepper motor with a step angle of 0.72° takes 60 steps per second. Calculate the speed of the stepper motor in rpm?
12. Let us assume a DC motor is operating at a speed of 2000 rad/sec for an input voltage of 15 V. The speed of the same DC motor is changed to 400 rad/sec by applying a PWM signal with an amplitude of 5 V. Calculate the percentage of duty cycle to achieve the above specified speed?
13. CAN bus is operating at a bit rate of 125 kHz. If the baud rate prescaler value is assigned with a value of 4. Calculate T_Q and T_{BIT} ? Assume XTAL = 20 MHz.
14. Calculate the time interval generated by executing the following code in PIC16F877 MCU,
for (i=0; i<100; i++)
for (j=0; j<50; j++);
Assume XTAL = 20 MHz.
15. A parallax 180° servo motor shaft position is controlled by supplying a PWM signal. The initial (-90°) and final ($+90^\circ$) shaft positions are obtained by providing a PWM signal with an ON time of $600 \mu\text{s}$ and $2400 \mu\text{s}$, respectively. The OFF time of the PWM signal is set to $20000 \mu\text{s}$. Calculate the ON time of a PWM signal to position the servo motor shaft to -40° .
16. What will be the value available in the variable temp for the following program?
unsigned int temp = 0xAA00;
void main()
{

```

ADCON1 = 0x80;
TRISA = 0xFF;
TRISB = 0x00;
while (1)
    {
        temp = ADC_Read(0);
        PORTB = temp;
    }
}

```

Assuming MCU contains a 8-bit ADC with a $V_{ref} = 5V$ and $V_{in} = 2.5 V$.

17. What percent of square wave duty cycle is generated by executing the following code?

```

unsigned short duty_value = 127;
void main()
{
    TRISC = 0x00;
    PWM1_Init(5000);
    PWM1_Start();
    PWM1_Set_Duty(duty_value);
}

```

18. What will be the output of following program?

```

Unsigned char Temp = 10;
asm {
    MOVLW Temp;
    MOVWF PORTB;
}

```

19. An 8-bit ADC with a reference voltage of 2.5 V is used to measure the sensor voltage (1.1 V).

Calculate the resolution of the ADC and the output bit pattern generated by it.

20. The data 'A' is being sent to the 16x2 LCD by microcontroller. To fetch the data from data line (D7 – D0) by the LCD, a high to low pulse signal of minimum _____ time period must be applied to the Enable line by the MCU. Assume XTAL = 20 MHz.

21. A 1000 rpm 5V DC motor is supplied with a pulse width modulated signal of 60 % duty cycle. Calculate the average voltage provided to the DC and also specify the speed at which the DC motor will be revolving?

22. What will be the output of the following program?

```

void main()
{
    UART1_Init(4800);
    Delay_ms(100);
    while (1) {
        if (UART1_Data_Ready() = 1) {
            UART1_Read_Text(output, "OK", 10);
            UART1_Write_Text(output);
        }
    }
}

```

```

    }
}
}

```

23. Stepper motor with a step angle of 1.8° is used for rotating a steel plate attached to its shaft. If the stepper motor is assumed to take 40 steps second. Calculate the speed of the motor in rpm?

24. Assume LEDs are connected to PORTB of PIC16F877MCU. What will be the output of following code?

```

void main()
{
  trisb=0xff;
  while(1)
  {
    portb=15;
    delay_ms(2000);
  }
}

```

25. LM35 temperature sensor is connected to the channel 0 of 8-bit ADC. For every 1°C variation, the sensor produces a voltage of 10 mV. If the current room temperature is assumed to be 30°C , calculate the output bit pattern produced by the ADC with a reference voltage of 1.25 V?

26. What is the maximum data rate supported by the extended I2C bus protocol?

27. Specify the number of MCU GPIO pins required to interface 16 switches in multiplexed fashion?

28. What is the minimum number of interface lines required for implementing SPI interface?

29. Calculate the number of transistors required to form a SRAM with 1 KB storage space?

30. A servo motor produces 180° rotation. The servo shaft position control is obtained by generating the PWM signal with different ON times. Initial and final shaft position of the servo motor is obtained by generating the PWM signals with ON time of 600 μs and 2400 μs , respectively. What should be the value of ON time in PWM signal to move the shaft by 30° from its initial position? Assume constant PWM frequency.

31. In which type of memory, the programming can be performed at sector level or page level without affecting the other sectors or pages?

32. An integer variable with value 255 stored in memory location at 0x8000. The processor word length is 1 Byte and the processor is a big-endian processor. The size of integer is considered as 4 bytes in the system. What is the value held by the memory location 0x8000?

33. To read the status of busy flag (D7 bit of command register) in liquid crystal display by MCU, what should be the signaling state of Enable line?

34. Which type of bridge circuit is used in the bidirectional control of DC motor connected to MCU?

35. A 10 rpm bi-phase stepper motor has a step angle of 2.5° . Calculate the number of steps taken by the stepper motor in a second?

36. The resolution of LM35 temperature sensor is 10 mV/ $^\circ\text{C}$. The sensor is connected to ADC of PIC16F877 MCU. Calculate the binary bit pattern obtained after the conversion process for an input ambient room temperature of 30°C . Assume the reference voltage to the ADC is of 3V.

37. How many address lines are required by the CPU to access 1024 memory cells?

38. An integer variable with value 255 is stored in memory location at 0x1500H. The processor word length is 8 bits and the processor is configured in big endian mode. The size of the integer is considered as 4 bytes in the system. What is the value held by the memory location 0x1500H?
39. Speed control of DC motor is achieved by generating a PWM signal (CCP1 module of PIC16F877 MCU) of 40 kHz frequency, 25% duty cycle and 5V as a peak voltage. Calculate the average voltage given to the DC motor?
40. A stepper motor connected to the MCU takes 12 steps per second. The speed of it is about 5 rpm. Calculate the step angle of the stepper motor?
41. What is the maximum range of data rate supported by Bluetooth technology?
42. What will be the frequency of operation for Bluetooth based communication interface?
43. Calculate the average voltage delivered to the DC motor by a PWM signal with a duty cycle of 75% and peak amplitude voltage of 5 V.
44. What is the maximum number of USB devices that can be connected to a USB host?
45. Consider a stepper motor is operating in Biphase 4-step sequence. The number of rotor teeth in the motor is about 50. Calculate the number of steps required by the motor to complete 3 revolutions?
46. PIC 16F877 MCU is used to trigger a camera every 5 seconds. What will be the MCU's mode of operation?
47. To obtain a baud rate of 9600 bps in PIC16F877 MCU, what should be the value to be loaded in SPBRG register? Assume XTAL = 20 MHz and BRGH = 1.
48. A DAC system is supplied with a input binary value of 10011001. Assuming $R = 5 \text{ k}\Omega$ and $I_{ref} = 2 \text{ mA}$, calculate the V_{out} generated by DAC?
49. Data is transmitted by the PIC16F877 MCU in asynchronous mode of serial communication. SPBRG register and BRGH registers are set with a value of 0x67 and 0x01, respectively. If 16 MHz crystal is connected to the MCU, determine the baud rate at which the data is transmitted?
50. A two phase 4-step stepper motor is rotated in clockwise direction by providing adequate signals from the MCU. Stepper motor has 45 numbers of rotor teeth and a step angle of 2 degrees. Calculate the number of steps required to complete one revolution. Also determine the number of times the 4-step sequence should be applied to move the stepper motor to 80 degrees?