

CS 5331-003: Special Problems in Computer Science: Embedded Systems

Instructor: Dr. Morshed, Associate Professor

Assignment-2: Microcontroller

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TEXAS TECH

U N I V E R S I T Y.

Problem 1 (40%)

If a product unit cost is \$40, and NRE cost is \$10,000, determine the minimum quantity of units to be produced to keep per-unit cost below \$50.

From the question,

$$\text{NRE Cost} = \$10,000$$

$$\text{Product Unit Cost} = \$40$$

$$\text{Per Unit Cost} = \text{below } \$50$$

Formula:

$$\text{Per Unit Cost} = \text{Unit Cost} + (\text{NRE} / \text{No. of Units})$$

Solution-1: From Trial and Error.

$$\text{Let per unit cost} = \$49.9$$

$$\$49.9 = \$40 + (\$10,000 / n)$$

$$\$10,000 / n = \$9.9$$

$$n = \$1010.10$$

$$\text{Let per unit cost} = \$49$$

$$\$49 = \$40 + (\$10,000 / n)$$

$$\$10,000 / n = \$9$$

$$n = \$1111.11$$

$$\text{Let per unit cost} = \$45$$

$$\$45 = \$40 + (\$10,000 / n)$$

$$\$10,000 / n = \$5$$

$$n = \$2000$$

Solution-2: From Inequality.

$$\text{Unit Cost} + (\text{NRE} / \text{No. of Units}) < \text{Per Unit Cost}$$

Assume n be the number of units.

$$\$40 + (\$10,000 / n) < 50$$

$$(\$10,000 / n) < \$10 \text{ (Subtract 40)}$$

$$\$10,000 < \$10n \text{ (Multiple } n\text{)}$$

$$\$1,000 < n \text{ (Divide by 10)}$$

$$n > \$1,000$$

In this case, the quantity of units increases as the cost falls. Therefore, in accordance with the query, we must ascertain the minimum quantity of units; that is, 1001 units if the unit cost is \$49.99 (less than 50).

Problem 2 (60%)

a) Write 4 differences between microprocessor and microcontroller.

Differences:

Microprocessor	Microcontroller
Microprocessor is the main component of a computer	Microcontroller is itself a small computer.
Contains one or more cores with ALU, register set, control unit.	Contains low complexity microprocessor core, memory, peripherals.
Has high processing capabilities and consumes high power	Low processing capabilities and consumes low power.
Used for general purpose computing (Ex: personal computer)	Used in embedded systems (Ex: car, TV, modem, IoT)

b) What is the manufacturer name and model number of the microcontroller that is used in Arduino Uno boards? What microprocessor architecture does it use?

The manufacturer name is Atmel (now acquired by Microchip Technology)

The model number is ATmega328P.

The microprocessor architecture used is AVR (8-bit RISC devices)

c) What are the port name and number for the following pins of Arduino Uno board?

Pin 4

Pin 10

Pin 15 (i.e., Analog Pin 1)

Pin 4 - known as Digital Pin 4 (D4)

Port Name: D

Port Number: 4 (PD4)

Pin 10 - known as Digital Pin 10 (D10)

Port Name: B

Port Number: 2 (PB2)

Pin 15 - known as Analog Pin 1 (A1)

Port Name: C

Port Number: 1 (PC1)

d) Write C code statements for Arduino Uno for the followings:

1. to set the Pin 7 mode to Output.
2. turn ON an LED connected to that pin.

1. to set the Pin 7 mode to Output.

```
pinMode(7, OUTPUT)
```

2. turn ON an LED connected to that pin.

```
digitalWrite(7, HIGH)
```

Complete C code:

```
void setup()
{
    pinMode(7, OUTPUT) #to set the pin 7 mode to output.
}

void loop()
{
    digitalWrite(7, HIGH); #turn ON and LED connected to the above
pin.
    delay(1000); #wait.
}
```

Output Screenshot:

