American International University-Bangladesh (AIUB)
Faculty of Engineering
Department of Electrical and Electronic Engineering (EEE)

Course Name:	Microprocessor and Embedded Systems	**Course Code:**	EEE 4103
Semester:	Fall 2024-25	**Term:**	Mid
Faculty Name:	Niloy Goswami	**Assignment #:**	01/02

Course Outcome Mapping with Questions

Item	COs	POIs	K	P	A	Marks	Obtained Marks
Q1	**CO2**	**P.a.4.C3**	**K4**	**P1, P3, P7**		**10**	
					Total:	**10**	

Student Information:

Due Date:	**20/11/2024**	**Submission Date:**		**19/11/2024**	
Student Name:	**MD. TANVIR RAHMAN MOLLA**				
Student ID #:	**22-46052-1**	**Department:**	**CSE**	**Section:**	**R**

Marking Rubrics (to be filled by Faculty):

Problem #	Excellent [9-10]	Proficient [7-8]	Good [4-6]	Acceptable [2-3]	Unacceptable [1]	No Response [0]	Secured Marks
	Detailed unique response explaining the concept properly and the answer is correct with all works clearly shown.	Response with no apparent errors and the answer is correct, but the explanation is not adequate/unique.	The response shows an understanding of the problem, but the final answer may not be correct	Partial problem is solved; the response indicates part of the problem was not understood clearly or not solved.	Unable to clarify the understanding of the problem and method of the problem solving was not correct	No Response/ copied from others/identical submissions with gross errors/image file printed	
Comments						**Total Marks (10)**	

Question # 1: Complete Table 1 after going through the datasheet of the specified microcontrollers.

Table 1

Specifications	ATMega328P	STM32F401RET6TR	STM32F205VG	ATMega2560	PIC16F628
Architecture Type	AVR 8-bit	ARM Cortex-M4	ARM Cortex-M3	AVR 8-bit	PIC 8-bit
Maximum Clock Speed	20 MHz	84 MHz	120 MHz	16 MHz	20 MHz
Program Flash Memory (kB)	32 kB	512 kB	1 MB	256 kB	2 kB

Specifications	ATMega328P	STM32F401RET6TR	STM32F205VG	ATMega2560	PIC16F628
SRAM (kB)	2 kB	96 kB	128 kB	8 kB	224 bytes
ADC Resolution	10-bit	12-bit	12-bit	10-bit	None
Operating Voltage Range (V)	1.8-5.5 V	1.8-3.6 V	1.8-3.6 V	4.5-5.5 V	2.0-5.5 V
Number of Timers	3	10	10	6	2
Number of PWM Channels	6	12	12	15	2
Communication Interfaces	USART,SPI,TWI	USART,SPI,12C	USART,SPI,12C	USART,SPI,TWI	USART,SPI

The unit prices of the above-mentioned MCUs are as follows: (1 USD = 118 BDT)

	ATMega328P	STM32F401RET6TR	STM32F205VG	ATMega2560	PIC16F628
Price	$3.60	$4.12	$3.9	$20	$1.9

XYZ Industry in Bangladesh is trying to develop an affordable shop security system, and they have shortlisted the listed 10 MCUs as possible candidates for their system CPU. The required minimum specifications for their intended design for the CPU are given below:

Minimum Clock Speed	16 MHz
Minimum SRAM	8 kB
Minimum ADC Resolution	12-bit
Minimum Program Memory	64 kB
Minimum Number of PWM Channels	12
Minimum Number of Timers	6
Required Serial Communication Interfaces	4 SPIs, 2 TWIs, 4 USARTs

Being a design engineer at *XYZ* Industry, you have been given the responsibility of selecting the most suitable IC from the list for the security system design that requires a minimum of 1000 microcontroller ICs.
Please select an IC from the list to design an affordable and efficient system and justify your answer with proper reasoning.

Solution:

Evaluation of Microcontrollers:

1. ATMega328P:

- Fails minimum requirements for SRAM (2 kB), ADC resolution (10-bit), and program memory (32 kB).

2. STM32F401RET6TR:

- Meets all specifications.

- Adequate clock speed (84 MHz), SRAM (96 kB), program memory (512 kB), ADC resolution (12-bit), and communication interfaces.

3. STM32F205VG:

- Exceeds specifications with higher program memory (1 MB), SRAM (128kB), and clock speed (120 MHz).

- Suitable for complex applications but more expensive.

4. ATMega2560:

- Meets most requirements but has a lower clock speed (16 MHz) and fewer communication interfaces.

5. PIC16F628:

- Fails on most parameters, including ADC resolution (no ADC), program memory (2 kB), and SRAM (224 bytes).

Selection:

The STM32F401RET6TR is the most suitable microcontroller because:

- It meets all design requirements (clock speed, memory, ADC, and PWM channels).

- It is affordable compared to STM32F205VG.

- Price per unit is $4.12; for 1000 units: 4.12 x 118 x 1000 = 486, 160 BDT. [As, 1 USD= 118 BDT]

Justification:

- The STM32F401RET6TR balances cost-effectiveness and performance.

- It supports the required communication interfaces, making it ideal for the security system.

So, the STM32F401RET6TR is recommended for the design, ensuring the security system is efficient, reliable, and affordable.