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

Final Assignment			
Course Name:	Microprocessor and Embedded Systems	**Course Code:**	EEE
Semester:	Spring 2023-2024	**Section:**	**J**
Faculty Name:	**Engr. Md Shaoran Sayem**		

Assignment No:	1F **(individual submission consisting of 30 marks)**

Submission Date:	**10/05/2024**	**Due Date:**	**02/05/2024**

Student Information:

Student Name:	**MD. ABU TOWSIF**											**Section:**	**J**
Student ID #:	**2**	**2**	**-**	**4**	**7**	**0**	**1**	**9**	**-**	**1**	**Assigned Date:** **25.04.2024**	**Department:**	**CSE**
	p	**q**	**-**	**a**	**b**	**c**	**d**	**e**	**-**	**r**			

Assessment Rubrics:

COs-POIs	Excellent [19-20]	Proficient [15-18]	Good [11-14]	Acceptable [6-10]	Unacceptable [1-5]	No Response [0]	Secured Marks
CO3 P.a.4.C.3	All the problems are solved correctly. The results are generated by combining all possible input patterns with appropriate outcomes. All necessary drawings and computations are shown correctly.	All the problems are solved correctly. The results are generated by combining all possible input patterns with appropriate outcomes. A few necessary drawings and computations are missing but no wrong drawing.	All the problems are solved correctly. The results are generated by combining all possible input patterns with appropriate outcomes. A few necessary drawings and computations are missing or wrong.	All the problems are not solved correctly. The results are generated by combining several wrong or less no of input patterns with in/appropriate outcomes. Some necessary drawings and computations are missing or wrong.	All the problems are not solved correctly. The results are generated by combining mostly wrong input patterns with inappropriate outcomes. Almost all the necessary drawings and computations are missing or wrong.	No responses at all or copied from others	
Comments					**Total Marks (20)**		

ANSWER TO THE QUESTION NO-01

Pq-abcde-r
22-47019-1

So, $f_{osc} = ac\ MHz = 40\ MHz = 40 \times 10^6\ Hz$.

$UBRRn = 0101101110 = 1454$

Now,
for Normal mode,

$$\text{Baud rate} = \frac{f_{osc}}{16(UBRRn+1)} = \frac{40 \times 10^6\ Hz}{16(1454+1)} = 1718.213 \approx 1718\ bps$$

Now,

$$\text{Baud error rate} = \frac{\text{standard baud rate} - \text{calculated baud rate}}{\text{standard baud rate}} \times 100\%$$

$$= \frac{1200 - 1718}{1200} \times 100\%$$

$$= -43.167\% \not< \pm 2\%$$

So, there will be communication error.

for, Double speed mode,

$$\text{Baud rate} = \frac{f_{osc}}{8(UBRRn+1)} = \frac{40 \times 10^6}{8 \times 1455} = 3436.43\ bps \approx 3436\ bps.$$

$$\text{Baud error rate} = \frac{2400 - 3436}{2400} \times 100\%$$

$$= -43.167\% \not< \pm 2\%$$

So, there will be communication error

For, Master mode.

$$\text{Baud rate} = \frac{f_{osc}}{2(UBRRn+1)} = \frac{40\times10^6}{2\times1455} = 13745.70 \approx 13746 \text{ bps.}$$

$$\text{Baud rate error} = \frac{14400 - 13746}{14400} \times 100\%.$$

$$= 4.54167\% \not< \pm 2\%$$

So, there will be communication error.

ANSWER TO THE QUESTION NO-02

Pa-abcde-r
22-47019-1

Here,

WGM02 = 1, WGM01 = 1, WGM00 = 1

So, Mode of operation : Fast PWM (mode-7)

Again,

CS02 = 0, CS01 = 1, CS00 = 1,

So, prescaler value 64

Furthermore,

COM0B1 = 1,

So, non-inverting mode.

Now, OCR0A = 200 + a + b + c = 200 + 4 + 7 + 0 = 211

OCR0B = 100 + d + e = 100 + 1 + 9 = 110

Now,
system clock frequency = 19 MHz = 12 MHz

Now,
for plotting the waveform we need to know its duty cycle for each mode,

So, for non-inverting mode,

$$OCR0A = \frac{256P}{100} - 1$$

$$\Rightarrow \frac{256P}{100} = OCR0A + 1$$

$$\Rightarrow 256D = (OCR0A + 1)100$$

$$\Rightarrow D = \frac{(OCR0A + 1)100}{256} = \frac{211 \times 100}{256} = 82.42\%$$

Waveform

Duty cycle: 82.42%

for, OCR0B = 110

$$\Rightarrow D = \frac{(OCR0B + 1)100}{256} = \frac{(110 + 1)100}{256} = 43.36\%$$

Waveform

Duty cycle: 43.36%

Now, operating frequency,

$$f_{OCnx PWM} = \frac{f_{CLK\_IO}}{N \times 256} = \frac{12 \times 10^6}{64 \times 256}$$

$$= 732.421 \text{ Hz}.$$

So, **Operating frequency = 732.421 Hz**

ANSWER TO THE QUESTION NO-03

Pq -	a	b	c	d	e -	r
22	-4	7	0	19	-1	

Now,

$OCR0B = 150 + a + b = 150 + 4 + 7 = 161$

Here,

$WGM02 = 0$, $WGM01 = 1$, $WGM00 = 1$,

So, Mode of operation : Fast PWM mode 3 (011)

Now, Prescaler,

$CS00 = 1$, $CS02 = 1$, So, $CS01 = 0$

So, Prescaler = 1024

Agin, $COM0B1 = 1$.

So, non inverting mode.

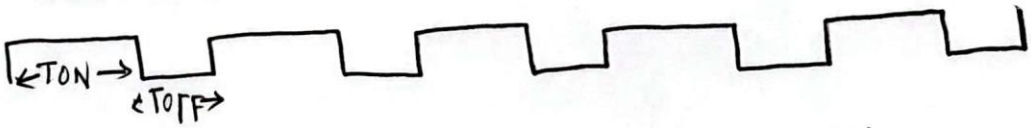
System clock frequency = Pq MHz = 22 MHz

Now, for duty cycle,

$$OCR0B = \frac{256\,D}{100} - 1$$

$$\Rightarrow D = \frac{(OCR0B+1)\times 100}{256} = \frac{(161+1)\times 100}{256} = 63.28\%$$

Waveform



Duty cycle: 63.28%

Now, system clock frequency,

$$f_{OCnxPWM} = \frac{f_{CLK-IO}}{N \times 256} = \frac{22\times 10^{6}}{1024 \times 256} = 83.92\,Hz$$

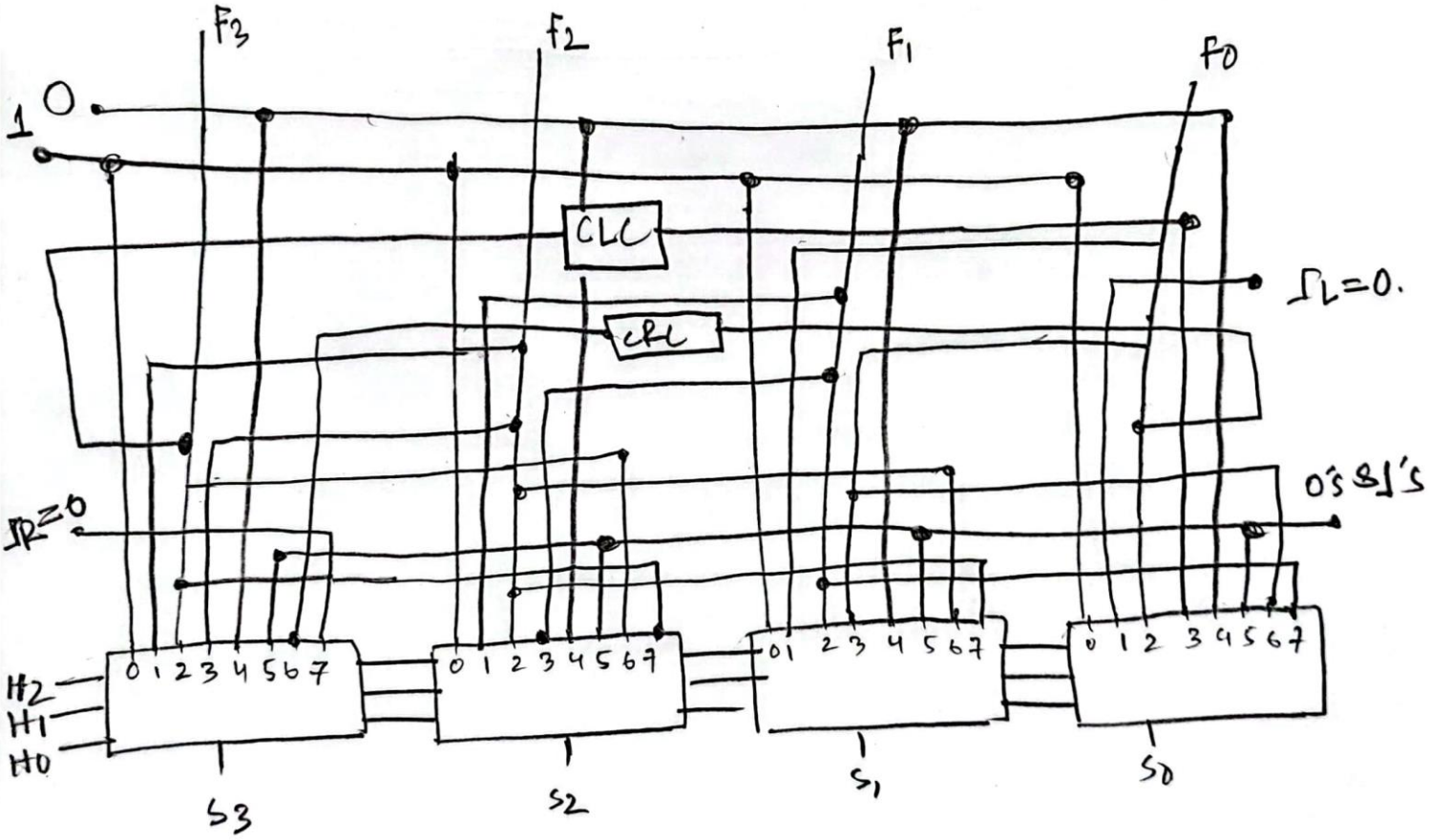
So, system clock frequency = 83.92 Hz

ANSWER TO THE QUESTION NO-04

Pq- abcde -r ⇒ 22- 47019 -1

So, a (4) bit shifter register

DESIGN:

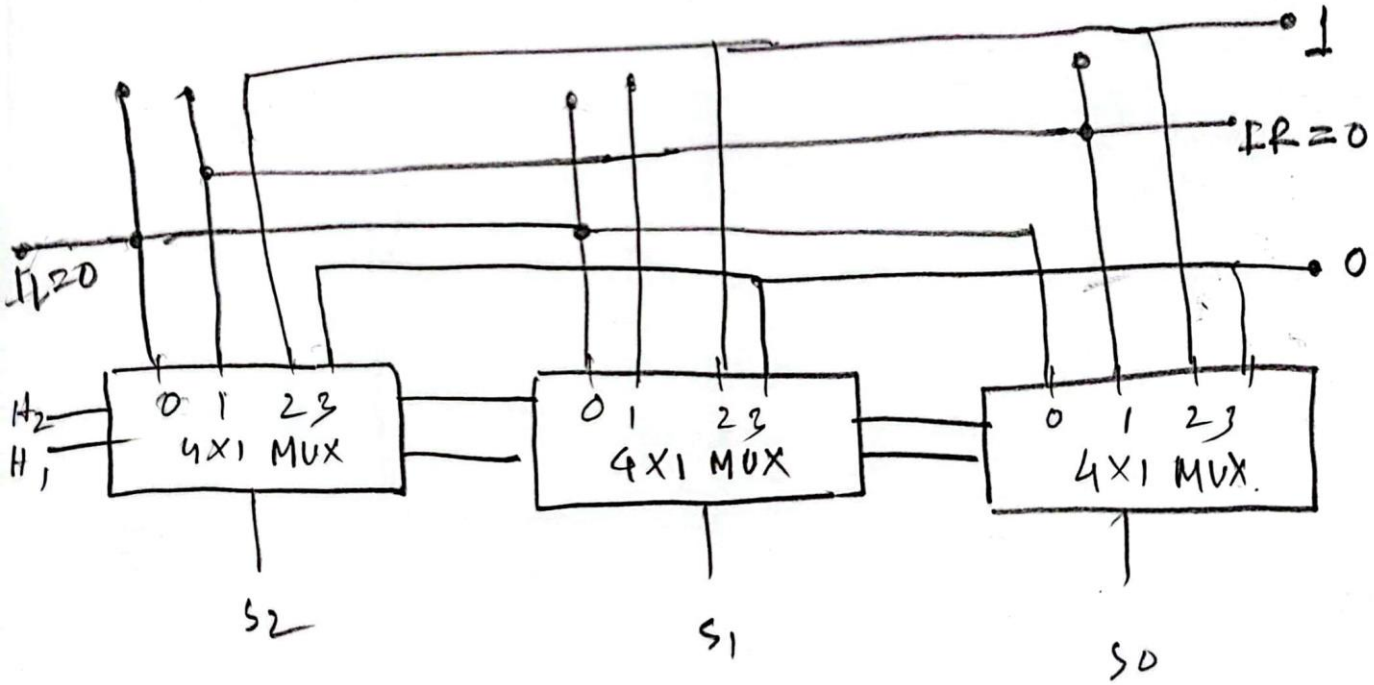


ANSWER TO THE QUESTION NO -05

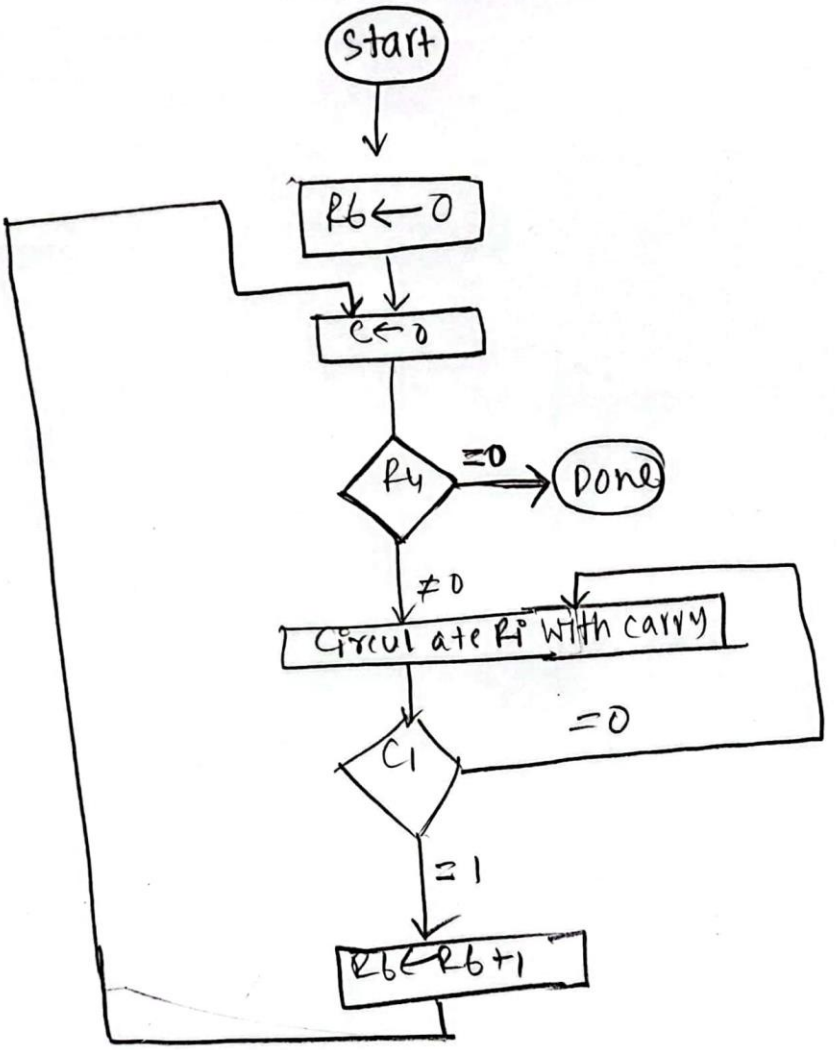
pq-abcde-r ⇒ 22-47019-1

(r+q) ⇒ 3 bit shifter

DESIGN:



ANSWER TO THE QUESTION NO-06.



Timing states	R_4								C	H_6
	1	1	0	1	0	0	1	1	0	0
T1	0	1	1	0	1	0	0	1	1	1
T2	0	0	1	1	0	1	0	0	1	2
T3	0	0	0	1	1	0	1	0	0	2
T4	0	0	0	0	1	1	0	1	0	2
T5	0	0	0	0	0	1	1	0	1	3
T6	0	0	0	0	0	0	1	1	0	3
T7	0	0	0	0	0	0	0	1	1	4
T8	0	0	0	0	0	0	0	0	1	(5)

ANSWER TO THE QUESTION NO-07

Par-abcde-Y
22-47019-1

Microoperation	Control Word A	B	D	F	Cin	H.
i. R7 ← R4 + R7	100	111	111	001	0	000
ii R1 ← 3(R7-0)3	111	000	001	000	0	000
iii R2 ← SHL R2	010	000	010	100	0	010
iv. Output ← R1	001	000	000	000	0	000
v. R1 ← R1	001	000	001	000	0	000
vi. R7 ← 0	000	000	111	000	0	000
vii. R2 ← Input	000	000	010	000	0	000
viii. R2 ← R2 - R4	010	100	010	010	1	000
ix. R1 ← SHR R7	111	000	001	100	0	001
x. R1 ← CRCR1	001	000	001	100	0	101

ANSWER TO THE QUESTION NO - 08

ROM Address			ROM outputs												
			Control Word								Address			Mux Select	
			1	2	3	4	5	6	7	8	10	11	12	13	14
0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	1
0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0
0	1	1	0	0	0	1	0	1	0	0	0	0	0	0	1
1	0	0	0	0	1	0	1	1	0	0	1	0	1	0	1
1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1
1	1	0	0	1	1	1	0	1	0	0	1	1	1	0	1
1	1	1	0	0	0	0	1	1	0	1	0	0	0	0	1