1 Multiple Choice 1 point Practice Question

Which register is used to divide the CPU clock frequency to generate a slower Timer Clock frequency?

- ○ Auto-Reload Register (ARR)
- ○ Capture Compare Register (CCR)
- ◉ Prescaler Register (PSC)
- ○ Control Register (CR1)

2 Multiple Choice 1 point Practice Question

5. In Center-aligned Counting Mode, the counter counts:

- ○ Up from 0 to ARR, then resets to 0.B.
- ○ Down from ARR to 0, then resets to ARR.
- ◉ Up from 0 to ARR, then Down from ARR to 0.
- ○ Randomly between 0 and ARR.

3 Fill in the Blank 10 points Binary Arithmetic and NZCV Flags Practice Question

Assume a 4-bit system. For each of the following operations, compute the result and NZCV flags, based on the first row that has been given to you. (If the result is incorrect, write the correct result in parenthesis like (true = 9).)

Binary Arithmetic

| Operation | Result in binary | Equivalent unsigned arithmetic in decimal | Equivalent signed arithmetic in decimal | NZCV |
|---|---|---|---|---|
| 0100 + 0101 | 1001 | 4 + 5 = 9 | 4 + 5 = −7 (true = 9) | 1001 |
| 1001 + 0010 | 1011 | 9 + 2 = 11 | -7 + 2 = -5 | 1000 |
| 0111 + 0110 | 1101 | 7 + 6 = 13 | 7 + 6 = −3 (tru | 1001 |
| 1010 − 1010 | 0000 | 10 − 10 = 0 | −6 − (−6) = 0 | 0110 |
| 1001 + 1001 | 0010 | 9 + 9 = 2 (true | −7 + −7 = 2 (tı | 0011 |

4 Fill in the Blank 10 points Register Calculation Practice

Given R0 = 0x81223344, write its value after executing each instruction (individually, not sequentially).

1) MOV R1, R0, ASR #4

R1 = 0x F8122334

2) MOV R2, R0, ASR #8

R2 = 0x FF812233

3) MOV R3, R0, ASR #16

R3 = 0x FFFF8122

4) MOV R4, R0, LSR #8

R4 = 0x 00812233

5) MOV R5, R0, LSR #31

R5 = 0x 00000001

5 Fill in the Blank 10 points Register Values Calculation II

Find the register values (in decimal) after finishing execution of the following program (sequentially, not individually).

```
MOV R6, #4
MOV R8, #3
MOV R6, R6, LSL
#5
ADD R9, R8, R8,
LSL #2
RSB R10, R9, LSL
#3
ADD R7, R6, R9
SUB R11, R10, R8
```

**Output:**

R6 = 128

R9 = 15

R10 = 105

R7 = 143

R11 = 102

6 Fill in the Blank 10 points C to Assembly I Practice Question

Consider the following C program. Fill in the blanks for the corresponding assembly programs (two versions).

| C Program | Assembly Program 1 (using branch statement) | Assembly Program 2 (using conditional execution) |
|---|---|---|
| if ((r1 == r3) && (r5 == r6))<br>  r7 = r7 + 10 | CMP  r1, r3<br>BNE  SKIP<br>[ CMP  r5, r6 ]<br>[ BNE  SKIP ]<br>[ ADD  r7, r7, #10 ]<br>SKIP: | CMP  r1, r3<br>[ CMPEQ  r5, r6 ]<br>ADDEQ  r7, r7, #10 |

7 Fill in the Blank 10 points C to Assembly I Practice Question

Consider the following C program that swaps the values of two chars. Fill in the blanks for the corresponding assembly program.

| C Program | Assembly Program |
|---|---|
| void swap (char *x, char *y) {<br>  char t;<br>  t = *x;<br>  *x = *y;<br>  *y = t;<br>} | swap PROC<br>EXPORT swap<br>  LDRB r2, [r0]  ; Load a byte, r0 = *x<br>  LDRB r3, [r1]  ; Load a byte, r1 = *y<br>[ STRB r2, [r1] ]<br>[ STRB r3, [r0] ]<br>  BX LR<br>ENDP |

8 Fill in the Blank 10 points Timer PWM Practice Question

Suppose a 16-bit timer has the following settings:

1. CPU clock frequency = 72 MHz.
2. The prescaler PSC = 71
3. ARR = 999
4. CCR = 250
5. Counting direction: down-counting
6. Output is set as PWM mode 1

Calculate Timer clock frequency = 1 MHz; Timer Frequency = 1 KHz; PWM duty cycle = 0.25.

9 Fill in the Blank 20 points Program execution Practice Question

Show all updates to registers as the assembly code shown below runs, assuming **little-endian** ordering. Fill in the tables of final register values and memory contents. Show the NZCV flags after execution, assuming NZCV=0000 initially. (Tip: LSLS is the only instruction that sets flags in this program.)

```
LDR  R1, =0x10000010
LDR  R2, [R1]
LDR  R3, [R1, #4]
MOV R4, R3, ROR #16
MOV  R5, 0x00000F00
LSLS  R6, R5, #8
BIC  R7, R2, R6
AND  R8, R7, R6
STR  R7, [R1, #8]
```

Initial memory content at 0x10000010 contains the following bytes in increasing memory address order:

| 0x10000010 | FF | EF | CD | AB | 00 | 00 | CD | AB | AA | BB | CC | DD | EE | FF | 11 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Final register values:**

R1 = 0x 10000010

R2 = 0x ABCDEFFF

R3 = 0x ABCD0000

R4 = 0x 0000ABCD

R5 = 0x 00000F00

R6 = 0x 000F0000

R7 = 0x ABC0EFFF

R8 = 0x 00000000

**Final memory contents:**

| 0x10000010 | FF | EF | CD | AB | 00 | 00 | CD | AB | FF | EF | C( | AE | EE | FF | 11 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Final NZCV** = 0000