

Question 1

a)

Question 1a [4+2+4]

a) Minimize the following equation using Boolean algebra and also draw circuit diagram.

$$AB + \bar{A}CD + \bar{A}BD + \bar{A}\bar{C}\bar{D} + ABC\bar{D}$$

| Simplification/Minimization steps | Circuit Diagram |
|--|-----------------|
| $AB(1+CD) + \bar{A}C(D+\bar{D}) + \bar{A}BD$ $AB(1) + \bar{A}C(1) + \bar{A}BD$ $AB + \bar{A}C + \bar{A}BD$ $B(A + \bar{A}D) + \bar{A}C$ $B((A + \bar{A})(A + D)) + \bar{A}C$ $B(1)(A + D) + \bar{A}C = B(A + D) + \bar{A}C$ | |

b) Divide (01010000) with (16) without using divider or add/subtract operations. Brief the method

b) Shift right 4 times [2 marks]

c) 0 10001011 011110000110000000...00

$$6.022 \times 10^3 = 6022$$

$$6022 = 1011110000110 \text{ in binary} = 1.011110000110 \times 2^{12}$$

$$\text{Exponent} = 12 + 127 = 139 = 10001011$$

For exponent – **2 marks**

For Signification – **2 marks**

If No normalization -- **-1**

Question 2

a. 101011 00101 00010 000...0011100 – 2 marks

If only opcode is correct, **0.5**

b. Mux before mem **2 marks**

Subtract values of Rs and memory read **1 marks**

BEM signal and zero flag should be ANDed **1 marks**

Mux before PC for PC+4, PC+offset etc **2 marks**

c. **0.25 marks for each correct signal value**

0

0

1

0

X

X

0

New control 1

Question 3

a. 9 cycles **2 marks** – Close enough might get 0.5

b. **Total marks 3**

1 incorrect -1 marks

2 incorrect -2 marks

2 correct 1 marks

| | |
|--------------------|-----|
| Instruction Fetch | SW |
| Instruction Decode | Add |
| Execution | LW |
| Memory Stage | Sub |
| Write back | Add |

c. PC+4 **1 marks**

Value of RT **1 marks**

Value of Rs + offset bits ... **1 marks**

Signal bits **2 marks**

0.25 for each signal [any 8 should be correct]

ALUOP 00

RegDst 0

ALUSrc 1

Memread 1

MemWrite 0

Branch 0

Mem to Reg 1

Reg write 1

PCSrc 0