higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

DIGITAL ELECTRONICS N5

6 AUGUST 2019

This marking guideline consists of 9 pages.

QUESTION 1

1.1 $237,7_8 \div A,7_{16}$

$237,7_8 = 10011111,111_2$ ✓ {Each octal decimal is represented by 3 binary bits}

$A,7_{16} = 1010,0111_2$

```
                    0 1 1 1 1, 0 1 0 ✓
10100111 √1 0 0 1 1 1 1 1 1 1 0,0 0 0
        -1 0 1 0 0 1 1 1
         1 0 0 1 1 0 0 0 1  ✓
        - 1 0  1 0 0 1 1 1
          1 0 0 0 1 0 1 0 1
           -1 0 1 0 0 1 1 1  ✓
            0 1 1 0 1 1 1 0 0
             -1 0 1 0 0 1 1 1
              0 0 1 1 0 1 0 1 0 0
                 -1 0 1 0 0 1 1 1
                  0 0 1 0 1 1, 0 1 0 ✓
```

∴ $10011111,111_2 \div 1010,0111_2 = 1111,010_2 = 17,2_8$ ✓

1.2 $37,6_8 \times 10,01_2$

$37,6_8 = 011\ 111,110_2 = 11111,11_2$ ✓ {Each octal decimal is represented by 3 binary bits}

```
                  1 1 1 1 1 1 1
              ×       1 0 0 1
                  1 1 1 1 1 1 1✓
            +1 1 1 1 1 1 1 0 0 0✓
```

Shift back the comma into three places $1\ 0\ 0\ 0\ 1\ 1\ 1,\ 0\ 1\ 1\ 1$ ✓✓

∴$37,6_8 \times 10,01_2 = 10010,001_2 = 47,7_{16}$ ✓

1.3 $29,5_{10} - 21,7_8$

$29,5_{10}$

2^4	2^3	2^2	2^1	2^0	2^{-1}
1	1	1	0	1	1

$29,5_{10} = 11101,1_2$ √

$21,7_8 = 010\ 001,\ 111 = 10001,111_2$ √ {each octal is represented by 3 binary bits}

11101,100 → 1 1 1 0 1 , 1 0 0
–10001,111 → 1sc → + 0 1 1 1 0 , 0 0 1 √
There is carry 1 0 1 0 1 1 , 1 0 0 √
Answer will be positive 0 1 0 1 1 , 1 0 0
Add carry to the L.S.B +1
1 0 1 1 , 1 0 1 √

Therefore $11101,1_2 - 10001,111_2 = 1011,101_2 = 11,625_2$ √

(3 × 6) **[18]**

QUESTION 2

2.1

A	**B**	**C**	**D**		J_A	K_A	J_B	K_B	J_C	K_C	J_D	K_D	
0	0	0	0		0	X	0	X	0	X	1	1	✓
0	0	0	1		0	X	0	X	1	X	X	X	✓
0	0	1	0		0	X	0	X	X	0	1	1	✓
0	0	1	1		0	X	1	X	X	1	X	X	✓
0	1	0	0		0	X	X	0	0	X	1	1	✓
0	1	0	1		0	X	X	0	1	X	X	X	✓
0	1	1	0		0	X	X	0	X	0	1	1	✓
0	1	1	1		1	X	X	1	X	1	X	X	✓
0	0	0	0		X	0	0	X	0	X	1	1	✓
1	0	0	1		X	1	0	X	0	X	X	X	✓

1010
1011
1100
1101
1110
1111

Don't cares (X's) ✓

(11)

2.2

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	0	0	X	X
$\bar{C}D$	0	0	X	X
CD	0	1	X	X
$C\bar{D}$	0	0	X	X

$J_A = BCD$ ✓

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	X	X	X	0
$\bar{C}D$	X	X	X	1
CD	X	X	X	X
$C\bar{D}$	X	X	X	X

$K_A = D$ ✓

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	0	X	X	0
$\bar{C}D$	0	X	X	0
CD	1	X	X	X
$C\bar{D}$	0	X	X	X

$J_B = CD$ ✓

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	X	0	X	X
$\bar{C}D$	X	0	X	X
CD	X	1	X	X
$C\bar{D}$	X	0	X	X

$K_B = CD$ ✓

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	0	0	X	0
$\bar{C}D$	1	1	X	0
CD	X	X	X	X
$C\bar{D}$	X	X	X	X

$J_C = \bar{A}\,D$ ✓

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	X	X	X	X
$\bar{C}D$	X	X	X	X
CD	1	1	X	X
$C\bar{D}$	0	0	X	X

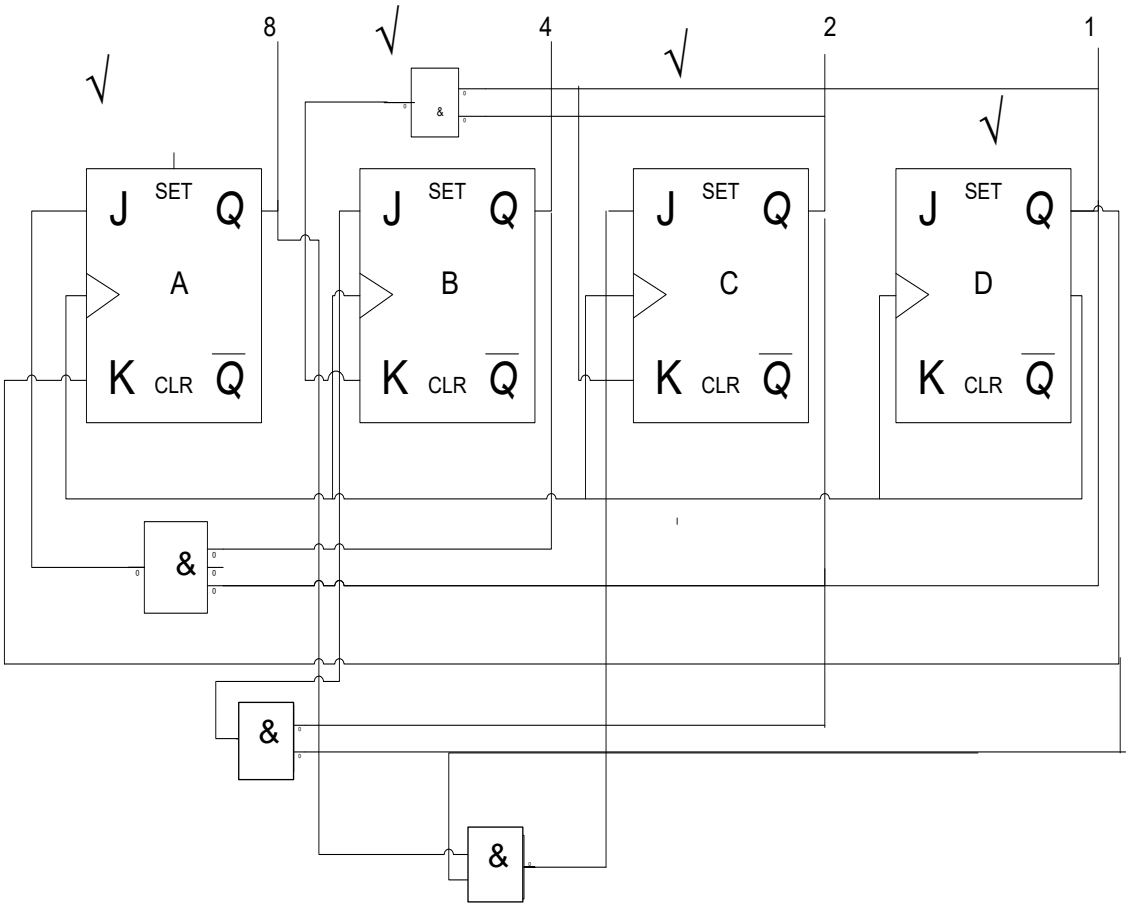
$K_C = D$ ✓

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	1	1	X	1
$\bar{C}D$	X	X	X	X
CD	X	X	X	X
$C\bar{D}$	1	1	X	X

	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}\bar{D}$	X	X	X	X
$\bar{C}D$	1	1	X	1
CD	1	1	X	X
$C\bar{D}$	X	X	X	X

$J_D = 1$ ✓ $K_D = 1$ ✓ (8)

2.3

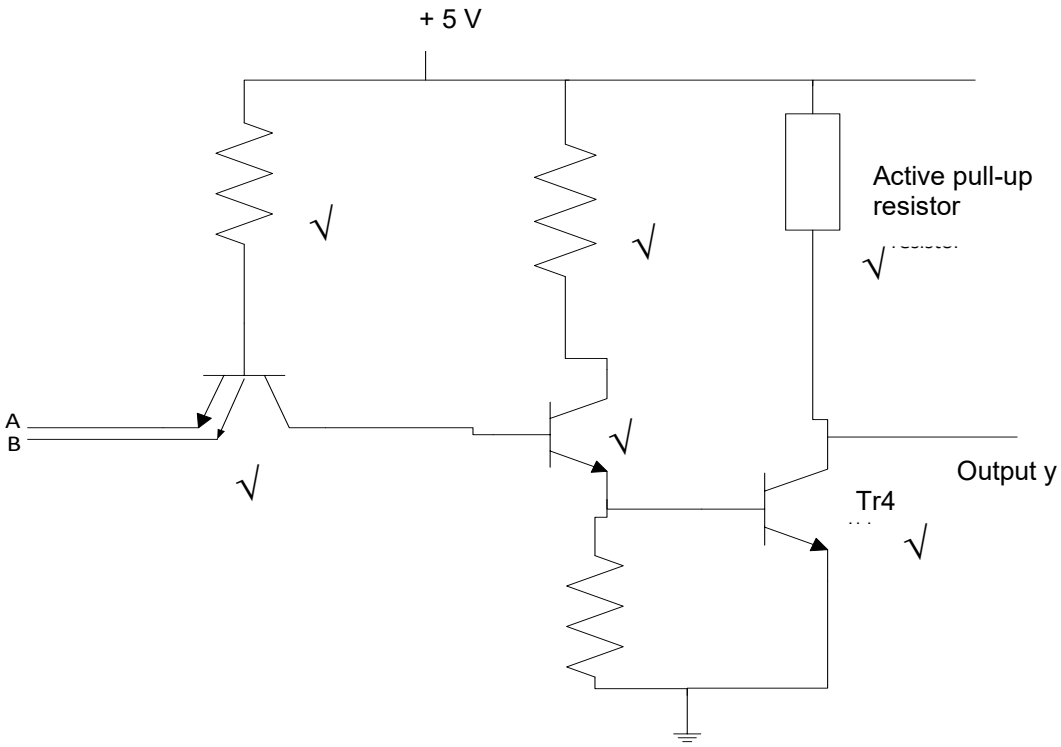


OR (6)

[25]

QUESTION 3

3.1



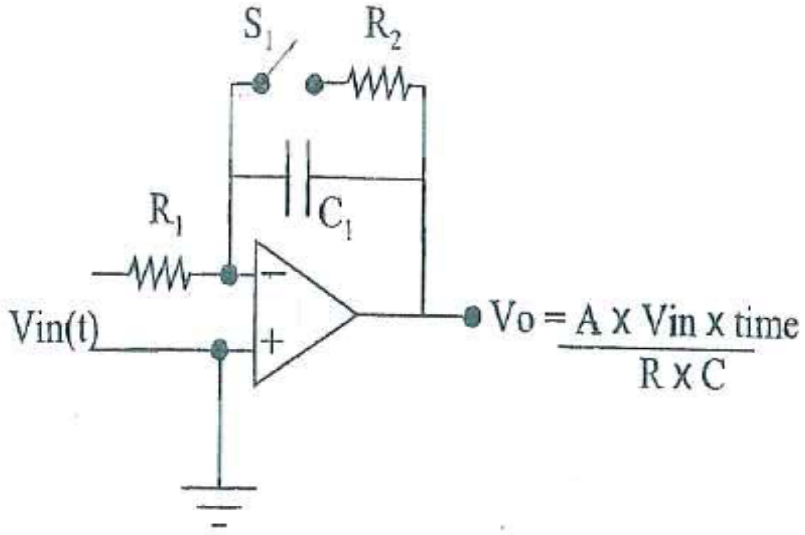
(6)

3.2
- Unused inputs should be connected to V_{CC} or ground. If left open, they will float to different levels.
- Always use conductive foam when storing MOS devices.
- Always place MOS devices with pins down on a ground surface.
- Ensure that tools, benches are earth-grounded.
- Never connect MOS devices with the power ON. (5)

[11]

QUESTION 4

4.1



$$V_o = \frac{A \times Vin \times time}{RC} = \frac{1\,024 \times 2{,}8 \times 1{,}2 \times 10^{-3}}{200 \times 10^{3} \times 250 \times 10^{-6}} = 0{,}069\ V$$

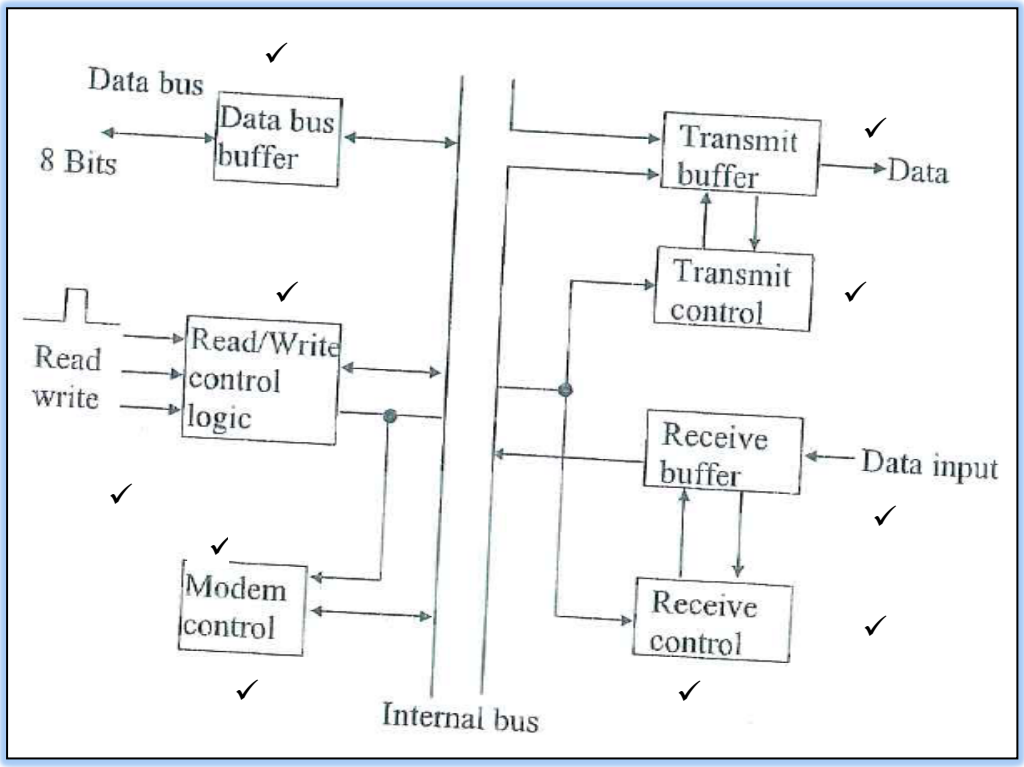
(8)

4.2
- The process starts when the counter is RESET by circuitry.
- Counts will proceed from 0 in step-size format until $V_A = V_R$.
- The conversion time will vary, depending on the analogue input (V_A).
- As long as the reference voltage is less than the analogue input voltage,
- the output of the comparator will stay high. Put the counter in the UP-count mode, which causes the counter to produce an UP-sequence of binary counts.

(5)
[13]

QUESTION 5

5.1



(10)

5.2

5.2.1	False
5.2.2	False
5.2.3	False
5.2.4	True
5.2.5	True

(5 × 1) (5)
[15]

QUESTION 6

6.1

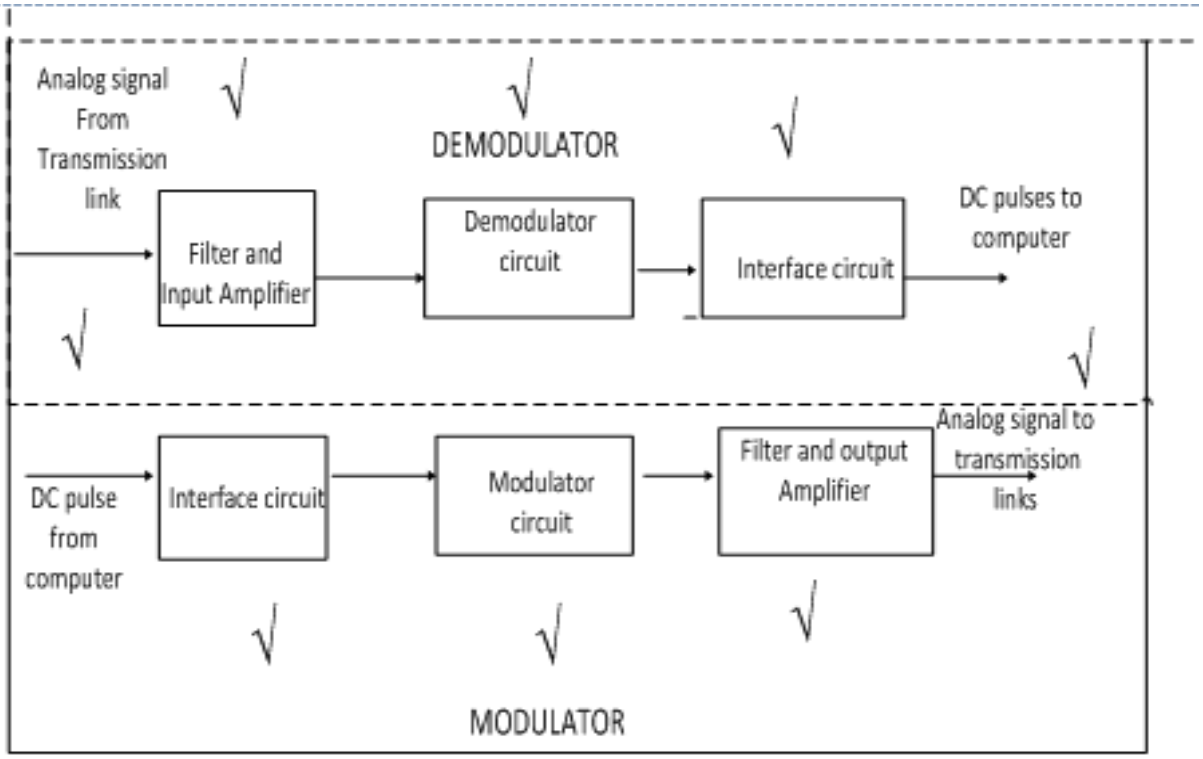
- Keyboard
- Mouse
- Joystick
- Image scanner
- Light pen
- Touch screen
- Digital camera
- Webcam
- Graphic tablet
- Microphone
- Printer
- Projector
- Barcode reader
- Game controller

(Any 3 × 1) (3)

6.2 6.2.1 A
6.2.2 A
6.2.3 D
6.2.4 A
6.2.5 C

(5 × 1) (5)
[8]

QUESTION 7



[10]

TOTAL: 100