TUTORIAL 1: Digital Logic Overview

1. Fill in the terms for the definition.

Term	Definition
i) Analog	Being continuous or having continuous values.
ii) AND gate	A basic logic operation in which a true (HIGH) output occurs only when all the input conditions are true (HIGH).
iii) clock	The basic timing signal in digital system.
iv) Digital	Related to digits or discrete quantities.
v) Pulse	A sudden change from one level to another, followed after a time, called the pulse width, by a sudden change back to the original level.
Risetime vi)	The time interval on the leading edge of a pulse between 10% and 90% of the amplitude

2. Find the duty cycle of a digital waveform if the period is twice the pulse width.

3. Name the device that is use for

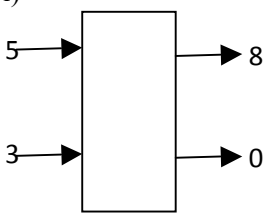
   i. converting a binary number to 7-segment display format.

   ii. data storage.

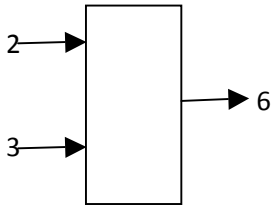
4. A basic 2-input logic circuit has a HIGH on one input and a LOW on the other input, and the output is LOW. Identify the circuit.

5. Name the logic function of each of the block below based on your observation of the inputs and outputs.

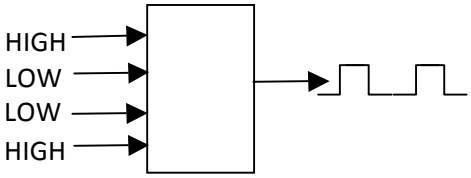
i)



ii)



iii)



6. A pulse waveform with a frequency of 10 kHz is applied to the input of a counter. During 100ms, how many pulses are counted?

7. A periodic digital waveform has a pulse width of 25 µs and a period of 150 µs. Determine the frequency and the duty cycle.

2. Find the duty cycle of a digital waveform if the period is twice the pulse width.

$2T = t_w$

$\text{Duty cycle} = \left(\frac{t_w}{2T}\right) \times 100\%$

$= 50\%$

3. Name the device that is use for

   i. converting a binary number to 7-segment display format.

   ii. data storage.

i) 7- segment display

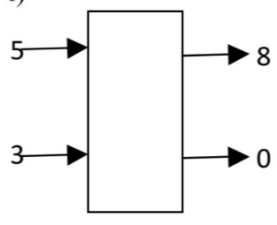
ii) Memory

4. A basic 2-input logic circuit has a HIGH on one input and a LOW on the other input, and the output is LOW. Identify the circuit.

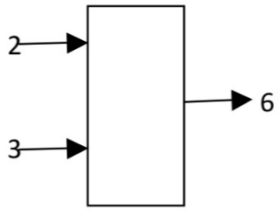
AND gate

5. Name the logic function of each of the block below based on your observation of the inputs and outputs.

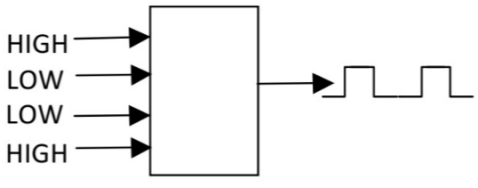
i)



ii)



iii)



i) Adder ii) Multiplier iii) Multiplexer

6. A pulse waveform with a frequency of 10 kHz is applied to the input of a counter. During 100ms, how many pulses are counted?

$f = 10\,kHz = 10 \times 10^3\,Hz$

$100ms = 100 \times 10^{-3}\,s = 0.1\,s$

$\text{Pulse} = 0.1(10 \times 10^3) = 1000$

7. A periodic digital waveform has a pulse width of 25 µs and a period of 150 µs. Determine the frequency and the duty cycle.

$T = 150\mu s = 150 \times 10^{-6}\,s$

$t_w = 25\mu s = 25 \times 10^{-6}\,s$

$f = \frac{1}{T} = \frac{1}{150 \times 10^{-6}} = 6666.67\,Hz$

$\text{Duty cycle} = \left(\frac{t_w}{T}\right)(100\%) = \left(\frac{25 \times 10^{-6}}{150 \times 10^{-6}}\right)(100\%) = 16.67\%$

8. i) List 3 main advantages of a digital system compared to an analog system.

   ii) An _____ is required to convert an analog signal to a digital signal, and a system that consist of both analog and digital circuits is called a _____ system

   iii) The smallest unit in a digital systems is called _____

   iv) Determine wheter the following is an analog or a digital quantities, circle the right answer

   1) A person weight ***Analog / Digital***
   2) Number of cars at the parking lot ***Analog / Digital***
   3) Storage capacity of a memory ***Analog / Digital***
   4) Tyre pressure ***Analog / Digital***

9 i) Determine the frequency of a waveform in Fig 1 if T is 10ms.

Fig 1

ii) Draw a digital waveform to represent the following digital value 1000101110 (left value first),if the pulse width is 1µs, determine the duration of each bit before it change to a new bit.

10. How many times the digital logic level changed in 1 second if the signal is a square wave with a frequency of 1MHz.

11. Draw a square wave with 25% duty cycle and clearly label the positive edge and the trailing edge.

12. List the suitable logical function for the following problems

   i) sending multiple input to a destination using a single cable : _____

   ii) converting a key press on a keypad to a BCD code : _____

   iii) determine the number of visitors to an expo : _____

   iv) determine whether a car exceed the speed limit : _____

   v) routing a different packet for a designated destination : _____

   vi) memorize characters type on a keyboard : _____

13. What is the difference between a fixed function IC compared to programmable IC

14. Determine which gate has the following property, assume FALSE = 0 and TRUE = 1
   a. Output is opposite of the input
   b. If both input FALSE then the output will be FALSE
   c. If one of the input FALSE the output will be FALSE

8. i) List 3 main advantages of a digital system compared to an analog system.

- ease of design
- ease of storage
- less affected by noise

ii) An Analog to Digital Converter (ADC) is required to convert an analog signal to a digital signal, and a system that consist of both analog and digital circuits is called a hybrid system

iii) The smallest unit in a digital systems is called bit

iv) Determine wheter the following is an analog or a digital quantities, circle the right answer

1) A person weight — ***Analog*** / ***Digital***
2) Number of cars at the parking lot — ***Analog*** / ***Digital***
3) Storage capacity of a memory — ***Analog*** / ***Digital***
4) Tyre pressure — ***Analog*** / ***Digital***

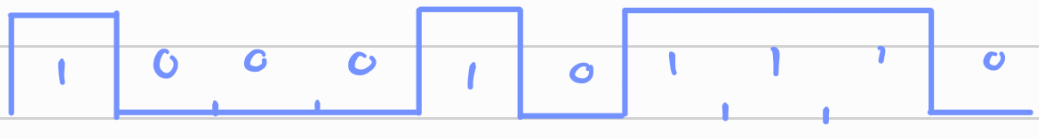
9 i) Determine the frequency of a waveform in Fig 1 if T is 10ms.

Fig 1

ii) Draw a digital waveform to represent the following digital value 1000101110 (left value first),if the pulse width is 1µs, determine the duration of each bit before it change to a new bit.

i) no consistent frequency

ii)



duration = 1µs

10. How many times the digital logic level changed in 1 second if the signal is a square wave with a frequency of 1MHz.

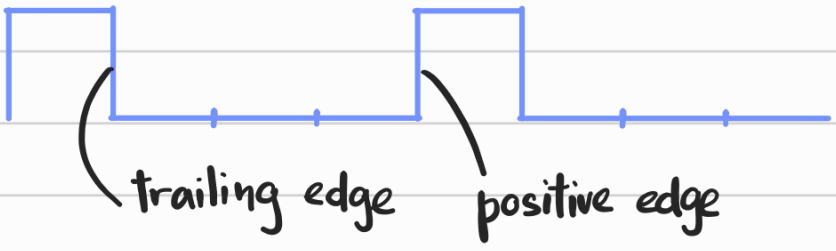
$f = 1 \times 10^6 Hz$

1 cycle = high, low (2 changes)

No. of changes $= 2 \times (1 \times 10^6)$

$= 200000$

11. Draw a square wave with 25% duty cycle and clearly label the positive edge and the trailing edge.



12. List the suitable logical function for the following problems

i) sending multiple input to a destination using a single cable : Multiplexer

ii) converting a key press on a keypad to a BCD code : Encoder

iii) determine the number of visitors to an expo : Counter

iv) determine whether a car exceed the speed limit : Comparator

v) routing a different packet for a designated destination : Demultiplexer

vi) memorize characters type on a keyboard : Memory

13. What is the difference between a fixed function IC compared to programmable IC

Fixed function IC - function of IC can't be changed

Programmable IC - function can be changed by reprogramming the IC

14. Determine which gate has the following property, assume FALSE = 0 and TRUE = 1

a. Output is opposite of the input NOT
b. If both input FALSE then the output will be FALSE OR/AND
c. If one of the input FALSE the output will be FALSE AND