

EGERTON UNIVERSITY

UNIVERSITY EXAMINATIONS

REGULAR NJORO MAIN CAMPUS

FIRST SEMESTER 2021/2022 ACADEMIC YEAR

SECOND YEAR RESIT/SPECIAL EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN COMPUTER SCIENCE

COMP 211: BASIC CIRCUIT DESIGN

STREAM: BSC (COMPUTER SCIENCE)

TIME: 2 HOURS

EXAMINATION SESSION: SEPTEMBER

YEAR: 2022

INSTRUCTIONS

- (i) This paper has **FIVE** questions
- (ii) Question **ONE** is compulsory
- (iii) Answer any other **TWO** questions from the remaining four.
- (iv) Extra answered questions will not be marked.
- (v) Electronic calculators **MUST** not be used.

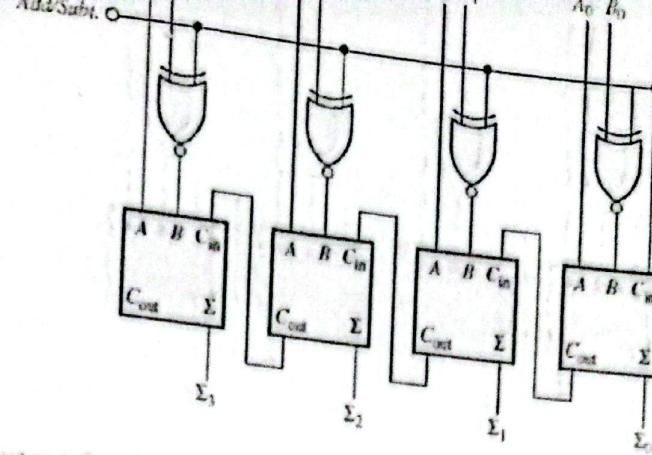
QUESTION ONE: 30 MARKS

- (a) What is the difference between the following:
 - a. A latch and a Flip flop [2 marks]
 - b. positive edge triggered and a negative edge triggered flip flop [2 marks]
- (b) What is a memory cell?
- (c) Explain what is meant by the term toggle state in J-K flip-flop and importance. [2 marks]
- (d) What is the difference between spatial locality and temporal locality? [3 marks]

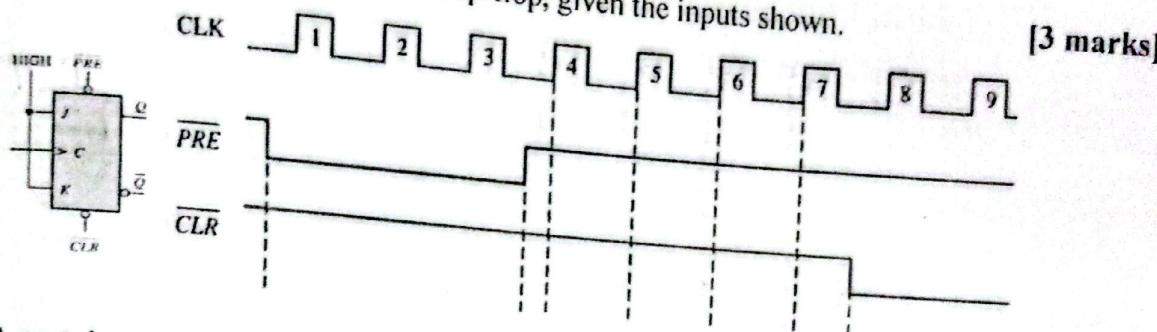
- (e) From first principles derive an expression for the speedup ratio of a memory system with cache (assume that the hit ratio is h , and the ratio of main store access time to cache access time is k , where $k < 1$). Assume that the system is an ideal system and that you don't have to worry about the effect of clock cycle times [4 marks]
- (f) Distinguish between cache miss and cache hit. [2 marks]
- (g) What do you understand by the following memory terminology?
- (i) Bandwidth
 - (ii) Latency
 - (iii) Seek time:
 - (iv) Memory refreshing: [4 marks]
- (h) What is memory hierarchy? What are the characteristics of memory hierarchy? Why does memory hierarchy provide economy? [4 marks]
- (i) A certain hard disk data sheet has the following parameters. Rotational rate 10,000 rpm, average seek time 9ms and average number of sectors/track is 500. Calculate the
- (i) rotational latency (T_{avg} rotation)
 - (ii) Transfer time (T_{avg} transfer) and
 - (iii) Total Average Access time (T_{access}) [6 marks]

QUESTION TWO: [20 MARKS]

- (a) What is the meaning of the following: -
- i) ISR [2 marks]
 - ii) Vectored Interrupts [3 marks]
- (b) The circuit shown below is a 4-bit circuit that can add or subtract numbers in a form used in computers (positive numbers in true form; negative numbers in complement form).
- (i) Explain what happens when the Add/Subt. input is HIGH. [3 marks]
 - (ii) What happens when Add/Subt. is LOW? [3 marks]
 - (iii) Assume the inputs are Add/Subt. 5 1, $A = 1010$, and $B = 1101$. What is the output? [3 marks]



- (c.) Determine the Q output for the $J-K$ flip-flop, given the inputs shown. [3 marks]



- (d.) A certain memory has a capacity of $1024K \times 32$. How many data input and data output lines does it have? How many address lines does it have? What is the capacity in bytes?

[3 marks]

QUESTION THREE: [20 MARKS]

- (a) Consider a logic circuit with two inputs called A and B , and two outputs called P_1 and P_2 .

Output P_1 is 1 if A is 1 AND B is 0

Output P_1 is 1 if A is 0 AND B is 1

Output P_2 is 1 if A is 1 AND B is 1

(i) Draw the Truth Table and Logic Circuit. [4 marks]

(ii) What type of circuit is described in (a) above? [1 mark]

(iii) Show how two of the above circuits can be utilized in the creation of one Full Adder circuit. [3 marks]

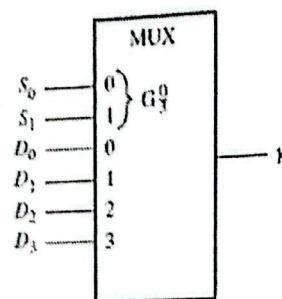
- (b) Each of the eight full-adders in an 8-bit parallel ripple carry adder exhibits the following propagation delay:

A to Σ and C_{out} : 20 ns
 B to Σ and C_{out} : 20 ns
 C_{in} to Σ : 30 ns

- C_{in} to C_{out} : 25 ns
- Determine the maximum total time for the addition of two 8-bit numbers. [4 marks]
- (c) Derive Logic expressions for the output carry (C_{out}), of each full adder stage for a 4-bit ripple carry adder. [8 marks]

QUESTION FOUR: [20 MARKS]

- (a) For the multiplexer below, determine the output for the following input states: $D_0 = 1$, $D_1 = 0$, $D_2 = 0$, $D_3 = 1$, $S_0 = 0$, $S_1 = 1$. [4 marks]



- (b) Determine the logic required to decode the binary number 1011 by producing a HIGH level on the output. [4 marks]

- (c) Design a decimal to BCD encoder and explain its operation. (Hint: Use the relationship between each BCD bit and the decimal digits of the BCD truth table in order to analyze the logic.

- a. Truth table [2 marks]
- b. Analysis [5 marks]
- c. Logic circuit [3 marks]
- d. Circuit operation [2 marks]

QUESTION FIVE:[20 MARKS]

- (a) A hard disk has 10 disks and 18 surfaces available for recording. Each surface is composed of 200 concentric tracks and the disks rotate at 7200 r.p.m. Each track is divided into 8 blocks of 256 64-bit words. There is one R/W head per surface and it is possible to read the 18 tracks of a given cylinder simultaneously. The time to step up from track to track is ms ($10^{-3}s$). Between data transfers the head is parked at the outermost track of the disk. Calculate:

- (i) The total capacity of the floppy disk in Kilo Bytes
- (ii) The maximum data rate in bits/second

- (iii) The average access time in milliseconds [2 marks]
- (iv) The average transfer rate when reading 256 blocks located randomly on the disk [2marks]
- (v) The recording density (bits/in) of the innermost and the outermost tracks if the disk has 6 in diameter and the outermost track comes to 1 in from the edge of the disk. The track density is 200 tracks/in. [3 marks]
- (b) What factors determine the drive performance (usually hard disk) of a computer system? [5 marks]
- (c) What is the difference between SIMM and DIMM? What is the major disadvantage of SIMM? [4 marks]
