UNIVERSITY OF GHANA
BACHELOR OF SCIENCE IN ENGINEERING
LEVEL 400 FIRST SEMESTER EXAMINATION
CPEN 413: MICROPROCESSOR SYSTEMS & INTEGRATION (3 Credits)

INSTRUCTION: *Answer all questions from section A and ANY four (4) from section B in your answer booklet.*

TIME ALLOWED: *TWO AND HALF (2¹/₂) HOURS*

SECTION A [20 marks]   *Answer all questions in this section.*

1.

a. Consider the 68000 program below and answer the following questions.
```
_main:
    LDAB  #$02
    STAB  $2025
    LDAA  #$01
    ADDA  $2025
    STAA  $1064
    SWI
```
    i.   What is the meaning of 'STAA $1064' in the program?   [2 mark]
    ii.   What operation does this program perform?   [1 mark]
    iii.   What will be the value of the accumulator after the operation?   [1 mark]

b.

    i.   What is the Stack Pointer (SP)?   [1 mark]
    ii.   Where can the Stack be found?   [1 mark]
    iii.   Describe how a byte put on to the stack or retrieved from the Stack affects the Stack pointer.   [2 marks]

c.

    i.   List the three possible conditions that will occur to the Status Register after an ALU operation.   [1 mark]
    ii.   Add the following binary numbers and describe what happens to the flag in each case: 0110101 and 0100001, 10000010 and 10100011 [2 mark]
    iii.   What is the function of Control Unit in c.ii above?   [1 marks]

d.

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i. If we have a total of 6 devices to decode what will be the minimum
    number of bits we would need to decode?   [2 mark]
ii. If we want to split the 68000 address space into 512 KB blocks, how
    many blocks are there?   [2 mark]
iii. How many bits do we need to differentiate between blocks? [2 mark]
iv. How many bits do we need to decode to choose locations within
    each block?   [2 mark]

SECTION B [80 marks]   *Answer ANY four questions in this section.*

2.

a. Using an Intel microprocessor explain how two binary numbers may be
    added. Illustrate your answer with the aid of a flowchart.   [7 marks]
b. Write a pseudo code for this flowchart.   [3 marks]
c. Code your answer in an assembly language of your choice.   [7 marks]
d. Modify the flowchart of 2a to take care of a subtraction operation. [3 marks]

3.

a. The hardware interface of the 68000 can be grouped into how many
    categories? Name them and give specific examples of each.   [3 marks]
b. Explain why the 68000 have more than one VCC and one GND in terms of
    clock phase operations.   [2 marks]
c. Explain specific examples of the three main address decoding techniques in
    an Intel microprocessor.   [5 marks]
d. With the help of an address decoder, a 74LS138 decoder and basic NOR and
    NAND-gates, draw the diagram of the 68000 Function Code outputs. Show
    how they may be interfaced to a User memory, User program Q memory,
    Supervisor program and Data memory.   [10 marks]

4.

a. What is bus and how many types does a microprocessor have? [3 marks]
b. Explain the usefulness of a bus in terms of the DEC PDP-8 bus
    structure.   [3 marks]
c. Contrast your answer in 4b with
    i.   the ENIAC bus structure and   [2 marks]
    ii. the von Neumann Machine.   [2 marks]
d. List the factors that led to speeding up of the above processors in 4c. Show
    how the density of dynamic RAM and processor characteristics have
    increased since 1980.   [5 marks]
e. Give the main characteristics of a VME bus in microcomputer. [3 marks]
f. List the two standard board sizes of the VME bus.   [2 marks]

5.

a. How does a microprocessor execute instructions?   [2 marks]
b. A microprocessor reads data from a keyboard at an average rate of 250
    characters per second. Write a program that will test that if no key has been

pressed, a branch is made back to the instruction that reads the status of the peripheral and the cycle continues until a key is pressed. [10 marks]

c. A manufacturer designs a single-board computer with eight pairs of byte-wide EPROMs to hold firmware. The designer decides to cater for three EPROM sizes: 4K * 8, 8K * 8, and 16K*8. Design an address decoder that will allow the size of each EPROM to be user selectable by means of jumper on the PCB. [8 marks]

6.

a. List the three main arithmetic instructions with skip. [3 marks]
b. In each case give two Assembly Language instruction op-codes for your answer. [3 marks]
c. With the aid of a well-labelled diagram, explain the term polling as used in microprocessors. [4 marks]
d. Write an Assembly Language Program to illustrate how the CPU polls for a connected input and output devices. [8 marks]
e. Describe how useful a multiple-polling is in any microprocessor. [2 marks]

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