(Knowledge for development)

KIBABII UNIVERSITY

(KIBU)

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

END OF SEMESTER EXAMINATIONS
YEAR FOUR SEMESTER ONE EXAMINATIONS

FOR THE DEGREE OF
(COMPUTER SCIENCE)

COURSE CODE : CSC 222

COURSE TITLE : ASSEMBLY LANGUAGE PROGRAMMING AND MICROPROCESSOR SYSTEMS

DATE: 12/5/2022 **TIME: 9.00 A.M – 11.00 A.M**

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTIONS ONE AND ANY OTHER TWO.

QUESTION ONE (COMPULSORY) [30 MARKS]

(a) Define the following terms applicable in assembly language programming for microprocessors

(i) Mnemonic [2 marks]
a symbolic code used to represent an operation or instruction

(ii) Operation code (or opcode) [2 marks]
part of ML instruction that specifies the operation to be performed by the processor, such as addition, sub etc.

(iii) Addressing modes [2 marks]
Defines how the operands of an instruction are specified in ALP.
Different AM determine how processor will access data from memory or register

(b) The processor controls the execution of instructions in three continuous steps. State and briefly describe the three steps. [3 marks]
1. Fetch: processor retrieves the next instruction from memory
2. Decode: processor interprets the instruction and determines operation needs to be performed.
3. Execute: processor carries out the operation specified by instruction.

(c) List the three types of statements that are found in the Assembly Language programs. [3 marks]
1. Label 2. Mnemonics 3. Operands 4. Comment

(d) Program segments define the addresses for the 8086 microprocessor when it fetches the instructions (opcodes and operands) from the code segments. For the program segment with the code segment (CS 2500) and an instruction pointer (IP 95F3), compute the following;

(i) Logical address [2 marks]
CS : IP 2500:95F3 OR (2500*16)+95F3= 4000 + 95F3

(ii) Offset address [2 marks]
IP 95F3

(iii) Physical address [2 marks]
2500 + 95F3 = 265F3H

(e) The main internal hardware of a PC consists of the **processor, memory** and **the registers**.

(i) Briefly state the role of registers in microprocessor systems [1 mark]
temporarily storing and manipulating data and instructions during processing

(ii) Illustrate using a diagram the anatomy of an extended register (32 bit). [3 marks]

(iii) State the roles of the following four general registers – EAX, EBX, ECX and EDX [4 marks]

(f) Consider an 8086 microprocessor assembly language instruction set below;

MOV dest, source ; copy source to destination

i. Briefly state the function of the above assembly language format [2 marks]
I. data movement operation, where the content of the source memory location is copied to the destination memory location.

ii. State the condition that must be met by both source and destination in terms of size and memory location [2 marks]
ii. Both the source and destination must be of the same size in terms of memory location it has to come from different memory locations.

-EAX is an extended accumulator used for arithmetic and logical operations holding operands and results.
-EBX is an extended base register used as a pointer to a data in memory or as a base address for memory access.
-ECX is an extended counter frequently used as a loop counter in repetitive operations such string manipulation or iteration in algorithms

a) writing low-level code that directly corresponds to the machine instructions understood by the microprocessor,

allows for precise control over the hardware and resources of the microprocessor, making it efficient for tasks that require direct manipulation of memory, registers, and input/output devices.

QUESTION TWO [20 MARKS]

(a) Explain the meaning of assembly language programming in microprocessor systems [2 marks]

d) 1. Low-level language
2. Mnemonics
3. Control over hardware
4. Efficiency.

(b) Assembly language is the most basic low level programming language available for any processor.

(i) State four important features of assembly language programming [4 marks]

(ii) List two high level conveniences that lack in assembly language programming [2 marks]

1. Lack of abstraction (no classes or functions
2. Portability: HLL programs run on diff OS while ALP tied to specific hardware platforms

(c) Assembly language statements are entered one statement per line.

(i) State the format which assembly language statements follow [2 marks]

Mnemonics Operand ;comment

(ii) Write an assembly language code that compiles and displays the string 'Hello World' on the screen [6 marks]

(d) Intel implemented the concept of pipelining by splitting the internal structure of the 8086 microprocessor into two sections that works simultaneously. List the two sections and briefly explain the roles for each [4 marks]

1)Instruction Fetch and Decode Section: fetching instructions from memory, decoding them into micro-operations, and preparing them for execution.
2) Execution Section: arithmetic and logic units, memory access units, and control units for managing the flow of data and instructions.

QUESTION THREE [20 MARKS]

a.ii) code segment
data segment
stack segment

(a) (i) Define the term **program segment** applicable in assembly language programming? [2 marks]

(ii) A typical Assembly language program consist of three segments. List the three segments [3 marks]

a.i) a section of code that performs a specific task within a larger program.

(b) Give three reasons why Disassembly Useful in Malware Analysis [3 marks]

1 it is not always desirable to execute malware: disassembly provides a static analysis.
2. Disassembly enables an analyst to investigate all parts of the codex, something that is not always possible in dynamic analysis. 3. Using disassembler and a debugger in combination creates synergy.

(c) State two ways for making increasing the speed of processing information in a CPU [2 marks]

1) Increasing Clock speed/frequency: more instructions can be executed per unit of time.
2) Parallel processing: multi-core processors or simultaneous multithreading (SMT) allows for parallel execution of multiple tasks.

(d) List three types of segment registers and briefly state the role of each in 8086 microprocessor systems [6 marks]

(e) State four advantages of assembly language programming for microprocessor systems [4 marks]

1. Efficiency: allows for direct control over the microprocessor
2. Low-level access: direct access to hardware resources, enabling precise control over system components.

QUESTION FOUR [20 MARKS]

3. Speed: to the minimal overhead and direct interaction with the hardware.
4. Size

(a) State two reasons why assembly language is considered to be more efficient than high level language such as C++? [4 marks]

(b) A computer must be able to take input, process it and produce output. binary code 1s and 0s

(i) How is the Information represented in a computer? [2 marks]

(ii) Briefly state how the input and output is presented in a form that is understood by users [2 marks]

(c) (i) Define the term stack applicable in program segmentation in assembly language programming [2 marks]

(ii) Operations of a stack utilizes two main syntax, PUSH and POP. Briefly state the role of each

a) 1) Control over hardware
2) Memory and speed optimization:
3)Reduced overhead

c. ii) PUSH: The PUSH operation is used to add data onto the top of the stack. It decrements the stack pointer and stores the data at the memory location pointed to by the stack pointer.
POP: The POP operation is used to remove data from the top of the stack. It retrieves the data from the memory location pointed to by the stack pointer, increments the stack pointer, and returns the data for further processing.

[4 marks]

(d) A FLAG register is a 16-bit register with six conditional flags and three control flags

(i) Illustrate using a diagram the structure of a flag register indicating the positions of all flags [4 marks]

(ii) Using the same diagram, state the positions that are reserved and undefined [2 marks]

QUESTION FIVE [20 MARKS]

(a) Define the following terms applicable in microprocessor systems and assembly language programming;

(i) CALL statement used to transfer control from the current program to a subroutine or a specific memory address. [2 marks]

(ii) Instruction format refers to the structure of an instruction, including the arrangement of fields such as opcode, operand specifier, and addressing mode [2 marks]

(b) An instruction set is usually composed of two parts, the first part is a mnemonic called the OPCODE, while the second part is composed of one or two words. Briefly state the role of the OPCODE and the word (s)

OPCODE (operation code) in an instruction set specifies the operation to be performed by the processor. words: operands or the data on which the operation specified by the OPCODE is to be performed. [4 marks]

(c) In the 8086 microprocessor systems, the two most ways in which the operand of an instruction are specified are register and immediate addressing modes. Briefly explain in three point form how each of the two addressing modes operate [6 marks]

(d) State how an overflow occurs in word sized signed numbers and how the register will manage this condition with the programmer [2 marks]

(e) State the role of the following assembler data directives in assembly language programming

(i) Origin (ORG) Specifies the starting address for the code or data in memory. [1 mark]

(ii) Data byte (DB) Reserves memory space to store one or more bytes of data. [1 mark]

(iii) Duplicate (DUP) Replicates a specified number of times the data defined in the directive. [1 mark]

(iv) Equate (EQU) Assigns a constant value to a symbol or label for later reference in the program. [1 mark]

d) by examining the sign bits of the operands and the result. If the sign bits do not match as expected based on the operation performed, overflow has occurred.
To manage overflow conditions, the processor sets an overflow flag in the status register.