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UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

SPECIAL/SUPPLEMENTARY EXAMINATIONS
YEAR TWO SEMESTER ONE EXAMINATIONS

FOR THE DEGREE OF
BACHELOR OF SCIENCE
(COMPUTER SCIENCE)

COURSE CODE   : CSC 222

COURSE TITLE   : ASSEMBLY LANGUAGE PROGRAMMING AND MICROPROCESSOR SYSTEMS

DATE: 27/07/2022   **TIME:** 11.00 A.M – 01.00 P.M

INSTRUCTIONS TO CANDIDATES

ANSWER **QUESTIONS ONE** AND **ANY OTHER TWO**.

QUESTION ONE (COMPULSORY) [30 MARKS]

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

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

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

Code Segment CS
Data Segment DS
Stack Segment SS

(b) A computer must be able to take input, process it and produce an output

(i) How is the Information represented in a computer? *Binary Code with 0s and 1s* [2 marks]

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

input devices (such as keyboards, mice, and touchscreens) to provide data and commands to the computer, and output devices (such as monitors, printers, and speakers) to present processed information in a human-readable format.

(c) 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) Physical address *2500 + 95F = 265F3H* [2 marks]

(ii) Logical address *CS : IP   2500:95F3* [2 marks]

d) 1. Low-level language
2. Mnemonics
3. Control over hardware
4. Efficiency: ALP can be highly optimized for performance and size, offer direct control over the microprocessor and enable programmers to write code tailored to specific hardware requirements.

(iii) Offset address *IP   95F3* [2 marks]

(d) 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

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

MOV dest, source; copy source to destination

i. data movement operation, where the content of the source memory location is copied to the destination memory location.

i. Briefly state the function of the above assembly language format [2 marks]

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.

(f) Give three reasons why disassembly is useful in malware analysis [3 marks]

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

f) 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.

g. 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.

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 TWO [20 MARKS]

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

(a) State five advantages of assembly language programming for microprocessor systems **[5 marks]**

4. Size: smaller in size compared to programs written in high-level languages, making them ideal for memory-constrained microprocessor systems.
5. Real-time applications; Assembly language is well-suited for real-time applications where timing and responsiveness are critical.

(b) List the three types of statements that consist the Assembly Language programs **[3 marks]**

Label Mnemonics Operands and Comments

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

R = Reserved
U = Undefined
Conditional
1) OF Overflow Flag
2) SF Sign Flag
3) ZF Zero Flag
4) AF Auxiliary
5) PF Parity Flag
6) CF Carry Flag

Control Flags: 1) DF Direction Flag   2) IF Interrupt Flag 3)TF Trap Flag

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

R R R R OF DF IF TF SF ZF U AC/AF U PF U CY

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

Reserved array: 15 14 13 12
Undefined array: 5   3 1

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

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

(ii) State the roles of the following four general registers – EAX, ECX and EDX **[3 marks]**

-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

QUESTION THREE [20 MARKS]

(a) The processor controls the execution of instructions in three continuous steps. State and briefly describe the three steps. **[3 marks]**

Fetch: retrieves instructions from memory
Decode: interprets instruction and determines operations
Execute: carries out operation

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

the register will set an overflow flag in the status register to indicate that the result is too large or too small to be represented accurately. The programmer can check this flag to detect and handle the overflow condition

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

i.   Operation Code   part of ML instruction that specifies operation to be performed **[1 marks]**
ii. Addressing mode defines how the operands of an instruction are specified in ALP **[1 marks]**
iii. Mnemonic in ALP it is a symbolic code used to represent an operation or instruction **[1 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.

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

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

Mnemonic operand ;comment

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

QUESTION FOUR [20 MARKS]

(a) 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)

[4 marks]

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

(i) CALL statement

[2 marks]

(ii) Instruction format

[2 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 the role of the following assembler data directives in assembly language programming

(i) ORG (origin)

[1 mark]

(ii) DB (Define byte)

[1 mark]

(iii) DUP (Duplicate)

[1 mark]

(iv) EQU (Equate)

[1 mark]

(e) Briefly state the role of registers in microprocessor systems

[2 marks]

QUESTION FIVE [20 MARKS]

(a) (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

[4 marks]

(b) State three reasons why assembly language is considered to be more efficient than high level language such as C++?

[6 marks]

(c) Explain the meaning of assembly language programming in microprocessor systems

[2 marks]

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

[6 marks]