University of Vavuniya, Sri Lanka

Third Examination in Information and Communication Technology - 2021

First Semester June / July 2023

TICT3113: Computer Architecture and Organization (Theory)

- ⊙ Answer **four questions** only.
- ⊙ This paper has **five questions** on **three pages.**
- ⊙ Time allowed: **Two Hours.**

1. (a) State two Architectural and Organizational attributes of a computer system. [20%]

   (b) State the main structural components of a computer with the aid of a diagram. Briefly describe each of the components. [20%]

   (c) List six registers name found inside the central processing unit and explain the purpose of any four registers. [15%]

   (d) Write down the sequence of states for the operation of **subtraction** of **B** from **A.** [20%]

   (e) Define what is an interrupt in process execution. [10%]

   (f) Draw a diagram to illustrate the instruction cycle with interrupt. [15%]

2. (a) What is meant by interconnection structures in computer organization? [10%]

   (b) Describe briefly the main functions of all 3-types of **buses** used in computer communication. [20%]

   (c) Consider a hypothetical 32-bit microprocessor having 32-bit instructions composed of two fields: the first byte contains the **opcode** and the reminder is **immediate operand** or an **operand address.**

      i. What is the maximum directly addressable memory capacity (in bytes)? [10%]

      ii. Describe the impact on the system speed if the microprocessor bus has:

         i. 32-bit local address bus and a 16-bit local data bus. [15%]

         ii. 16-bit local address bus and a 16-bit local data bus. [15%]

   (d) Indicate the exchanges of each module (CPU, I/O module, Memory) in the forms of input and output. [30%]

3. (a) State the usage of hexadecimal numbering in computer science. [10%]

(b) What the general approach can be applied to convert a number from **base P** to **base Q**? The base Q is the power of base P; E.g. from base 3 to base 9 (3^2) or from base 2 to base 4 (2^2) or base 8 (2^3) [15%]

(c) Find the result of **101011** - **111001** in base 2 using 2's complement method. Use 8 bit representation. [20%]

(d) Compute the value for P, P=X*Y where X=3 and Y=(-6) with 4-bit using Booth's Algorithm. [25%]

(e) Figure 1 shows the flow chart for Unsigned Binary Division using restoring algorithm. Perform the operation of division (7/3) using restoring 2's complement. [30%]

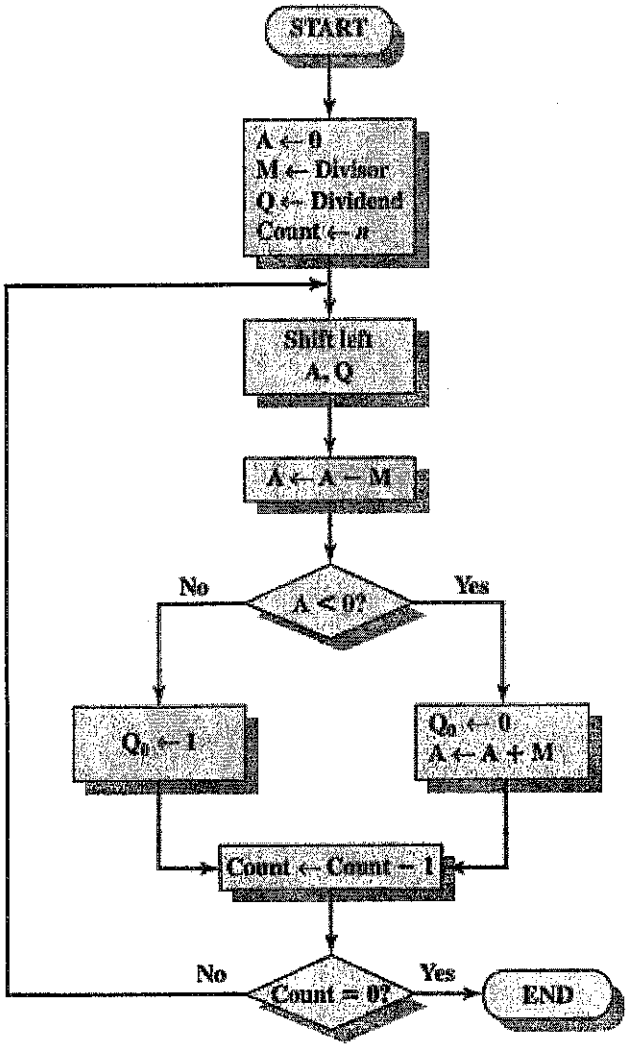

Figure 1:

4. (a) Define an instruction in your own word and describe the instruction format in computer architecture. [20%]

   (b) Write a program to evaluate the arithmetic statement given below using a general register computer with two operand instructions. (Use a temporary location T to store the intermediate results if it is necessary)
   X = A*(B + C) + D/E*F + G [30%]

   (c) What do you understand by addressing modes and explain why computer uses addressing mode techniques. [20%]

   (d) List different type of addressing modes and describe briefly any two with suitable diagrams. [30%]

5. (a) State the purpose of cache memory in computer organization and explain how does it work. [10%]

   (b) Illustrate the memory hierarchy with example and list its key characteristics in each level of the hierarchy. [20%]

   (c) What is mapping? Explain the differences between direct mapping and associative mapping. [20%]

   (d) Consider a memory system that uses a 32-bit to address at the byte level, a cache that uses a 64-byte line size. Assume a direct mapped cache with a tag field in the address of 20 bits. Determine the following parameters:

      i. Number of addressable units. [5%]

      ii. Number of blocks in main memory. [10%]

      iii. Number of lines in cache. [10%]

      iv. Draw the address format by indicating tag bits, line bits and word bits. [10%]

      v. Size of main memory and Cache memory. [15%]

End