

The Open University of Sri Lanka
 Department of Electrical and Computer Engineering
 Bachelor of Software Engineering Honours
EEX3373 Communication and Computer Technology

Academic Year: 2022/2023
 Examination: Final Examination
 Duration: Three (03) hours



Date: 29th October 2023

Time: 0930 – 1230

Instructions:

- This question paper has four (04) questions in five (05) pages.
- **Answer all questions.**
- This is a closed-book type test.
- Do not use red colour pens for answering questions.
- Non-programmable calculators are allowed.

Q1.

I.

- a) Briefly explain "Control Unit, Arithmetic-Logic Unit, Accumulator, Data Bus, Address Bus, Instruction Register, Program Counter, Flags".
(8 Marks)
- b) With the help of a diagram, explain how the above components work together in a "Accumulator architecture" processor when an instruction executes.
(4 Marks)

- II.** Briefly explain the POST (Power On Self Test) and how it is important to computers.
(3 Marks)

- III.** Cubic polynomials are used in various areas of mathematics and science, including physics, engineering, and economics. A polynomial is an algebraic expression (equation) with variables and constants with exponents as whole numbers. Following equation is such a polynomial.

$$y = 4x^3 + 8x^2 + 2x + 2$$

Considering the Accumulator-Based Processor Architecture, draw a single flowchart to show the algorithm of the assembly program to calculate the answer (y) of the above polynomial. Store the output of the equation 'y' in the 0x71 memory location. Assume the value of 'x' is stored in the 0x70 memory location. Mention if you made any assumptions.

Important: Use the standard symbols/ shapes to draw the flowchart. Assume the size of the memory is enough to store your program.

(15 Marks)

- IV.** Write an assembly program for the above (Q1, III) algorithm. Refer to the ISA in Appendix A to write the program.

(10 Marks)

Q2.

- I. Compare the features of Von Neumann Model and Harvard Model using a table. (4 Marks)
- II. Convert the following binary number to decimal. Show the immediate calculation steps. (6 Marks)
 - a) Convert 10111.0101_2 to its decimal equivalent.
 - b) Convert 101101001011101_2 to its hexadecimal equivalent.
 - c) Convert 385.37_{10} to its binary equivalent.
 - d) Convert 1111010001 to its octal equivalent.
- III. Perform following operations. (5 Marks)
 - a) $101.001 * 101$
 - b) Find the 'x' of the following equation by using the 2's complement method.
 $x = 37 - 73$
- IV. Convert -257.29_{10} numbers to IEEE 754 Single precision format (5 Marks)

Q3.

- I. Modulation and demodulation are very important in Communication. (05 marks)
 - a. Briefly explain the terms modulation and demodulation.
 - b. Draw the appropriate basic communication block diagram with modulator and demodulator blocks.
- II. The amplitude modulated signal $AM(t)$ is given as,
 $AM(t) = A_c \cos \cos (4000\pi \times 10^3 t) + A_m \cos \cos (4000\pi t) \cos \cos (4000\pi \times 10^3 t)$
 and the output waveform is shown in **Figure 1**.
 A_c and A_m are the amplitude of carrier signal and modulating signal.

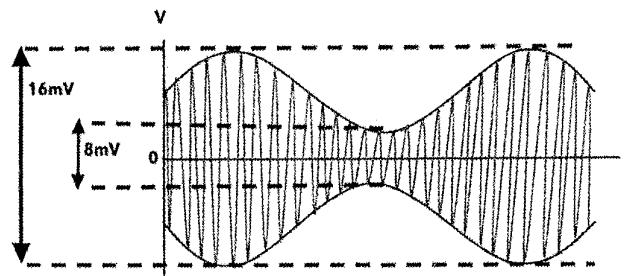


Figure 1

- a) Find the modulation index, m_a
- b) Find the carrier frequency f_c and message frequency f_m .
- c) Find the frequency of upper and lower sidebands and bandwidth of the modulated signal.
- d) If the amplitude of the message signal is increased to 6mV, what will happen to the modulated signal, explain. (09 marks)
- III. A carrier signal $A_c \cos \cos \omega_c t$ is angle modulated by a modulating signal,
 $x(t) = 6 \cos \cos 30\pi \times 10^3 t$, then find the modulation index and bandwidth of the PM system.
 $K_p = 15\text{KHz/volt}$. (04 marks)

- IV. For the digital message signal (110100) and carrier signal shown in Figure 2, draw the output waveforms of On-Off keying (OOK).

(02 marks)

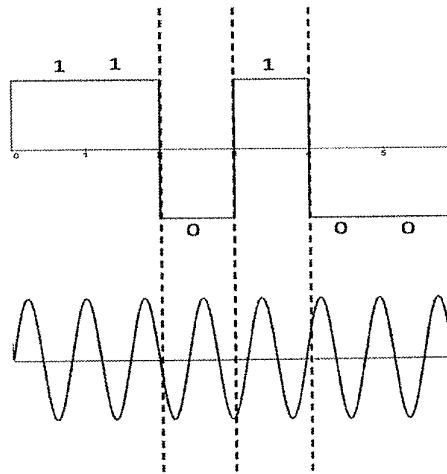


Figure 2

Q4.

- I. Define the following terms in networking.

- Domain Name Server (DNS)
- Gateway Address
- ARP (Address Resolution Protocol)
- Server

(04 marks)

- II. Explain the reason for using shielded twisted pair cables in networking instead of unshielded, untwisted pair cables.

(02 marks)

- III. How do you know whether two IP addresses are on the same subnet? Explain using an example.

(02 marks)

- IV. OUSL has 4 regional centers across different areas in Sri Lanka. Number of hosts in a regional center is given in brackets. **Colombo (511), Kandy (420), Matara (234), Badulla (80)**. IP address of the main IP block is **172.108.121.86/19**

- Find the network address of the main IP block.
- What is the maximum number of usable hosts that can accommodate in the main IP block without subnetting?
- Perform subnetting the given network for the branches according to the given order. (Calculate **network address, subnet mask, starting host address, ending host address and the broadcast address** of each subnet in the part iii)

(12 marks)

Accumulator Architecture

Mnemonic	Syntax	Operation	Description	Add Mode	Flags affected
Arithmetic instructions					
ADD	ADD AM x	Addition	$Acc \leftarrow Acc + op$	# & default	ZF, OF, SF, CF, PF = 1
SUB	SUB AM x	Subtraction	$Acc \leftarrow Acc - op$	# & default	ZF, OF, SF, CF, PF = 1
MUL	MUL AM x	Signed multiplication	$Acc(16\text{ bit}) \leftarrow Acc(8\text{ LSBs}) * op(8\text{ LSBs})$	# & default	ZF, SF, PF = 1, OF, CF = 0
DIV	DIV AM x	Unsigned division	$Acc \leftarrow Acc / op2$	# & default	ZF, SF, PF = 1, OF, CF = 0
INC	INC	Increment by 1	$Acc \leftarrow Acc + 1$	# & default	OF, SF, ZF, PF = 1
Logical instructions					
AND	AND AM x	Bit-wise And	$Acc \leftarrow Acc \text{ AND } op$	# & default	OF, CF = 0; SF, ZF, PF = 1
OR	OR AM x	Bit-wise OR	$Acc \leftarrow Acc \text{ OR } op$	# & default	OF, CF = 0; SF, ZF, PF = 1
XOR	XOR AM x	Bit-wise XOR	$Acc \leftarrow Acc \text{ XOR } op$	# & default	OF, CF = 0; SF, ZF, PF = 1
SHL	SHL	Shift left by 1-bit	$CF \leftarrow Acc(\text{MSB}), op \leftarrow Acc(14\text{ down to }0) \& 0$	Implied (A)	CF = bit shifted by Acc, SF, ZF, PF = 1
SHR	SHR	Shift right by 1-bit	$CF \leftarrow Acc(\text{LSB}), Acc \leftarrow 0 \& Acc(15\text{ down to }1)$	Implied (A)	CF = bit shifted by Acc, SF, ZF, PF = 1
ROL	ROL	rotate left by 1-bit	$CF \leftarrow Acc(\text{MSB}), op \leftarrow Acc(14\text{ down to }0) \& CF$	Implied (A)	CF = bit shifted by Acc, SF, ZF, PF = 1
ROR	ROR	rotate right by 1-bit	$CF \leftarrow Acc(\text{LSB}), Acc \leftarrow CF \& Acc(15\text{ down to }1)$	Implied (A)	CF = bit shifted by Acc, SF, ZF, PF = 1
NOT	NOT	One's complement negation	$Acc \leftarrow \text{NOT } Acc$	Implied (A)	none
Control Transfer instructions					
Conditional Branches					
JC	JC d	Jump if carry	If CF = 1 then $PC \leftarrow PC + \text{Operand}$	PC relative	none
JOF	JOF d	Jump if over-flow	If OF = 1 then $PC \leftarrow PC + \text{Operand}$	PC relative	none
JS	JS d	Jump if Sign	If SF = 1 then $PC \leftarrow PC + \text{Operand}$	PC relative	none
JP	JP d	Jump if parity	If PF = 1 then $PC \leftarrow PC + \text{Operand}$	PC relative	none
JZ	JZ d	Jump if result is zero	If ZF = 1 then $PC \leftarrow PC + \text{Operand}$	PC relative	none
Unconditional branch					
JUMP	JUMP d	Jump	$PC \leftarrow PC + \text{Operand}$	PC relative	none
Loops					
LOOP	LOOP d	Loop until zero	Count $\leftarrow$ Count - 1, IF Count = 0; Loop termination ELSE: $PC \leftarrow PC + \text{operand}$	PC relative	none
Calls and Returns					
CALL	CALL d	Procedure call	implied return address $\leftarrow PC, PC \leftarrow$ immediate address	*	none
RETURN	RETURN	Return from procedure	$PC \leftarrow$ Contents of implied return address	**	none
Miscellaneous instructions					
NOP	NOP	No operation		none	none
Data Movement instructions					
LOADacc	LOADacc AM d	Copy the operand to the accumulator	Immediate: $Acc \leftarrow op$; Direct: $Acc \leftarrow \text{memory}(op)$	#, default	none
STOREacc	STOREacc AM d	Copies the accumulator to the memory address	Direct: $\text{Memory}(op) \leftarrow Acc$; Indirect: $\text{Memory}(\text{memory}(op)) \leftarrow Acc$	default, &	none

*Immediate operand is used as the jumping location.

**Contents of the implied return address is used as the jumping location

x- Memory Address or immediate value, d- Displacement

Addressing Modes -AM
 Immediate
 Direct
 Indirect

 default (blank)
 &