



UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
MARCH 2025 SEMESTER SESSION

SUBJECT CODE : LEB21903

SUBJECT TITLE : MICROPROCESSOR

PROGRAMME NAME : BACHELOR OF ELECTRICAL AND ELECTRONICS
(FOR MPU: PROGRAMME LEVEL) ENGINEERING TECHNOLOGY (MARINE) WITH HONOURS

TIME / DURATION : 2.00 PM - 5.00 PM
(3 HOURS)

DATE : 24 JUNE 2025

INSTRUCTIONS TO CANDIDATES

1. Please **CAREFULLY** read the instructions given in the question paper.
 2. This question paper has information printed on both sides of the paper.
 3. Answer **FOUR (4)** questions **ONLY**.
 4. Please write your answers on the answer booklet provided.
 5. Answer all questions in English language only.
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THERE ARE 7 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

TOTAL: 100 Marks

INSTRUCTION: Answer FOUR questions ONLY.

Please use the answer booklet provided.

Question 1

- (a) Explain **FOUR (4)** characteristics that distinguish embedded systems from general-purpose computing systems.

(8 marks)

- (b) The Status Register (SREG) in the ATmega32 plays a critical role in decision-making during instruction execution.

- i. Explain the purpose of **FOUR (4)** keys flags within SREG.

(4 marks)

- ii. Determine which SREG flags are affected based on the following instructions below.

```
LDI R16, 0xFF
```

```
LDI R17, 0x01
```

```
ADD R16, R17
```

(4 marks)

- (c) Two ROM chips have a capacity of 16k and 256k bits. Calculate: -

- i. The organization for both chips

(5 marks)

- ii. The number of address pins for these memory chips

(4 marks)

Question 2

- (a) Identify **THREE (3)** advantages and **ONE (1)** disadvantage of having separate bus for each memory in AVR microcontroller.

(8 marks)

- (b) Determine the flag of status register and the content of the register after the execution of following instructions in sequence in Table 1.

(8 marks)

Table 1

	Instruction	Register	NZVC
i.	LDI R16, 0x78 LDI R17, 0x34 SUB R16, R13		
ii.	ROR R16		
iii.	LSL R16		
iv.	COM R16		

- (c) Outline the instructions to do the following: -

- i. Add the contents of PINB to PIND.

(5 marks)

- ii. Stores the result in location 0x300.

(2 marks)

- iii. Send the result to the input/output register of Port C.

(2 marks)

Question 3

(a) Identify the addressing mode for each of the following: -

- i. ST X+, R17 (2 marks)
- ii. LDD R16, Y+50 (2 marks)
- iii. ANDI R20, 0B11101010 (2 marks)
- iv. IN R18, 0x32 (2 marks)

(b) A configuration byte is stored at memory location 0x310. Bit 3 (zero-based index) needs to be toggled (i.e., if it is 1, make it 0; if 0, make it 1). The modified byte must be stored in memory location 0x311. Outline AVR assembly instructions to: -

- i. Load the byte from memory. (2 marks)
- ii. Load mask with bit 3 set. (2 marks)
- iii. Toggle bit using EOR. (2 marks)
- iv. Store result to 0x311. (2 marks)

(c) Identify the instructions based on the comments given to bring in a byte of data serially through pin RC7 and save it in R20 register. Each line is sequential.

- i. _____ ; set bit 7 of port C as input (1 mark)
- ii. _____ ; load R16 with value 8 (1 mark)
- iii. _____ ; load R20 with zero (1 mark)
- iv. AGAIN: _____ ; skip the next line if bit 7 of port C is 0 (1 mark)
- v. _____ ; set carry flag to one (1 mark)

- vi. _____ ; skip the next line if bit 7 of port C is 1
(1 mark)
- vii. _____ ; clear carry flag to zero
(1 mark)
- viii. _____ ; rotate right R20
(1 mark)
- DEC R16
- ix. _____ ; if R16 is not zero go to AGAIN
(1 mark)
- HERE: JMP HERE ; stop here

Question 4

- (a) An embedded system typically consists of a few components that work together to execute a specific, dedicated task. Describe **FOUR (4)** of the components.
(8 marks)
- (b) In AVR microcontrollers like the ATmega32, addressing modes determine how data is accessed during instruction execution. Two commonly used addressing modes are I/O direct and data direct addressing. Each mode serves different purposes based on the structure and requirements of the program.
 - i. Analyze how I/O direct and data direct addressing modes are used in ATmega32.
(4 mark)
 - ii. Outline one example of each addressing mode.
(4 mark)
- (c) Identify the instructions based on the comments given.

----- Program to check if the internal RAM location \$195 contains an even value. If so, send it to Port B. If not, make it even and then send it to Port B.

- i. _____ ; set aside location 0x195 (MYREG)
(1 mark)
- ii. _____ ; load R16 with 0xFF
(1 mark)

- iii. _____ ; make Port B an output port (1 mark)
- iv. AGAIN: _____ ; load MYREG to R16 (1 mark)
- v. _____ ; bit test D0, skip if set (1 mark)
- vi. _____ ; go to OVER if LOW (1 mark)
- vii. _____ ; clear bit D0 = 0 (1 mark)
- viii. OVER: _____ ; copy it to Port B (1 mark)
- ix. _____ ; go to AGAIN (1 mark)

Question 5

- (a) The ATmega32 microcontroller is built on the AVR RISC architecture, which feature a well-defined general-purpose register set. Explain:-
 - i. Explain the purpose of the general-purpose register set in the AVR architecture. (2 marks)
 - ii. Describe **TWO (2)** advantages of using 32 general-purpose register in Atmega32. (4 marks)
 - iii. Identify an example of instruction that make use of these registers. (2 marks)
- (b) Determine the content of Table 1 after the execution of each instruction.

```
.INCLUDE "M32DEF.INC"
.ORG 0
LDI R16, HIGH (RAMEND)
OUT SPH, R16
LDI R16, LOW (RAMEND)
OUT SPL, R16
LDI R31, 0
```

```

LDI      R20, 0x21
LDI      R22, 0x66
PUSH     R20
PUSH     R22
LDI      R20, 0
LDI      R22, 0
POP      R22
POP      R31
    
```

(8 marks)

Table 1

Num.	After the execution of:-	Contents of some of the registers		
		R20	R22	SP
i.	OUT SPL, R16			
ii.	LDI R22, 0x66			
iii.	PUSH R20			
iv.	PUSH R22			

- (c) Assume that PB2 is used to control outdoor light, and PB5 to control light inside a building. Construct a program to turn "ON" the outdoor light and turn "OFF" the inside light by using logic instructions.

(9 marks)

END OF QUESTIONS