TUNKU ABDUL RAHMAN UNIVERSITY OF MANAGEMENT AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATION TECHNOLOGY

ACADEMIC YEAR 2024/2025

OCTOBER EXAMINATION

BACS1113 COMPUTER ORGANISATION AND ARCHITECTURE

MONDAY, 14 OCTOBER 2024 TIME: 2.00 PM – 4.00 PM (2 HOURS)

BACHELOR OF COMPUTER SCIENCE (HONOURS) IN DATA SCIENCE
BACHELOR OF COMPUTER SCIENCE (HONOURS) IN INTERACTIVE SOFTWARE TECHNOLOGY

BACHELOR OF INFORMATION SYSTEMS (HONOURS) IN ENTERPRISE INFORMATION SYSTEMS

BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN INFORMATION SECURITY
BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN INTERNET TECHNOLOGY
BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN SOFTWARE SYSTEMS DEVELOPMENT

BACHELOR OF SCIENCE (HONOURS) IN MANAGEMENT MATHEMATICS WITH COMPUTING

BACHELOR OF SOFTWARE ENGINEERING (HONOURS)

Instructions to Candidates:

Answer **ALL** questions. All questions carry equal marks.

Question 1

a) Carry out the following operations and show the answers in the respective number base. (You are required to show your working steps clearly.)

(i) $511.1_9 - 23.8_9$ (2 marks)

(ii) $78H \times CCH$ (2 marks)

(iii) $110011.01_2 - 11111.1_2$ (2 marks)

b) Perform the following conversions. (Show your conversion steps clearly. If the question is illogical, state the reason.)

(i) $5AB3_{16}$ to a base-2 number (2 marks)

(ii) 456.2_6 to a base-8 number (2 marks)

(iii) 40.27_8 to a base-16 number (2 marks)

(iv) 234.2_5 to a base-10 number (2 marks)

c) Assume that floating point is represented in SEEMMMMM format where S is the sign, EE is a 2-digit exponent value, and MMMMM is a 5-digit mantissa:

- An Excess-55 notation is applied.
- The implied decimal point is immediately to the left of the first number of the mantissa.
- A "9" is used to represent a positive number and a "5" is used to represent a negative number.

(i) Subtract these two numbers. Present your result in SEEMMMMM and magnitude notation format. (3 marks)

55634001
95245123

(ii) Divide these two numbers. Present your result in decimal format. (3 marks)

55634001
95245123

d) Demonstrate how the following fractional number -0.0000011101111011_2 is represented in the computer system using *IEEE 754 single precision* format. You are required to show your working steps clearly. (5 marks)

[Total: 25 marks]

Question 2

a) Assuming a 16-bit microprocessor is used to solve the following operation:

$512_{10} - 342_{10}$

(i) Solve the operation above using Two's complement representation. (5 marks)

(ii) Validate your answer by showing the answer in signed decimal value with justification. (3 marks)

(iii) Does overflow and / or carry occur? (2 marks)

b) Assume the Little Man Computer (LMC) model is used and the following instructions are found at the given memory locations:

Program Counter: 88
Value stored in memory location 41: 041_{10}
Value stored in memory location 42: 042_{10}
Value stored in memory location 43: 043_{10}
...
...
Value stored in memory location 88: 541_{10} *(LOAD instruction)*
Value stored in memory location 89: 242_{10} *(SUB instruction)*
Value stored in memory location 90: 343_{10} *(STORE instruction)*

Evaluate and show the changes in the contents for *Instruction Registers (IR), Program Counter (PC), Memory Address Register (MAR), Memory Data Register (MDR), and Accumulator (A)* respectively immediately after the execution of the following instructions: *(You are required to list down all the instruction steps.)*

(i) Memory location 88 (5 marks)

(ii) Memory location 89 (5 marks)

(iii) Memory location 90 (5 marks)

[Total: 25 marks]

Question 3

a) Assume a 1200 x 800 picture. Calculate the storage size required to store each of the followings:

(i) 512-color bitmap in megabytes. (4 marks)

(ii) 512-bit color in kilobytes. (3 marks)

b) ***X*** is a computer processor designed to have large number of instructions, and each of the instruction will perform many actions that take several clock cycles to complete.

(i) Identify the type of instruction set architecture used by processor ***X*** in Question 3 b). (2 marks)

(ii) Explain any **TWO (2)** benefits of ***X.*** (6 marks)

c) Direct Memory Access (DMA) is a method of transferring data between peripherals and memory without using the CPU. State the **THREE (3)** primary conditions that must be met by DMA in order to take place. (6 marks)

d) Give any **TWO (2)** differences between a bitmap image and an object image. (*You are required to compare your answer using a table.*) (4 marks)

[Total: 25 marks]

Question 4

a) Assume that EBX is zero. Trace the program snippets and fill in the following data and register values from i) until vi) in hexadecimal. (10 marks)

```
.DATA
VAL1 WORD  0209H
VAL2 DWORD 00300000H
VAL3 QWORD 1000000500200100H

.CODE
INC VAL1                          ;i) VAL1 =
MOV AX,VAL1
XOR AX,102H                       ;ii) AX=
NOT AX                            ;iii) AX=
DEC VAL2                          ;iv) VAL2 =
MOV EDX,DWORD PTR VAL3+4          ; v) EDX =
MOV EAX,DWORD PTR VAL3            ;vi) EAX=
```

b) Trace the following code and determine whether the jump action to the label named Q4 will be taken? (*You are required to justify your answer.*)

```
MOV BX, -50(10)
CMP BX, 50(10)
JA Q4
```

(3 marks)

c) (i) What is symmetrical multiprocessing? (2 marks)

(ii) Briefly explain any **TWO (2)** benefits of symmetrical multiprocessing. (6 marks)

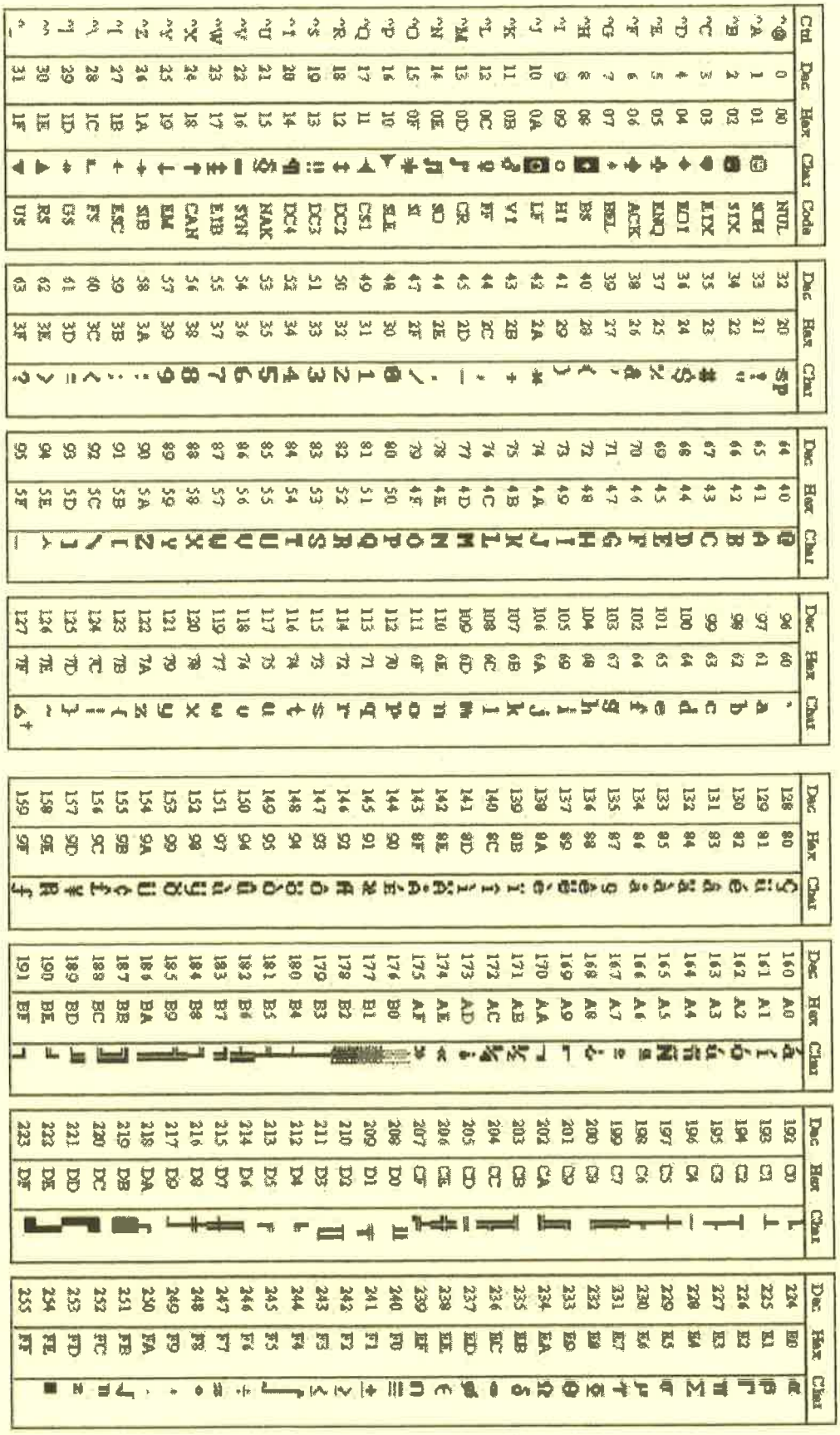
d) Complete the Table 1 below: (4 marks)

Basic comparison	Loosely coupled multiprocessor system	Tghtly coupled multiprocessor system
Memory conflict		
Data rate		

Table 1: Comparison between loosely coupled and tightly coupled multiprocessor systems.

[Total: 25 marks]

ASCII TABLE



Ctrl	Dec	Hex	Char	Code
^@	0	00	@	NUL
^A	1	01	A	SOH
^B	2	02	B	STX
^C	3	03	C	ETX
^D	4	04	D	EOT
^E	5	05	E	ENQ
^F	6	06	F	ACK
^G	7	07	G	BEL
^H	8	08	H	BS
^I	9	09	I	HT
^J	10	0A	J	LF
^K	11	0B	K	VT
^L	12	0C	L	FF
^M	13	0D	M	CR
^N	14	0E	N	SO
^O	15	0F	O	SI
^P	16	10	P	DLE
^Q	17	11	Q	DC1
^R	18	12	R	DC2
^S	19	13	S	DC3
^T	20	14	T	DC4
^U	21	15	U	NAK
^V	22	16	V	SYN
^W	23	17	W	ETB
^X	24	18	X	CAN
^Y	25	19	Y	EM
^Z	26	1A	Z	SUB
^[	27	1B	[	ESC
^\	28	1C	\	FS
^]	29	1D	]	GS
^~	30	1E	~	RS
^_	31	1F	_	US

Dec	Hex	Char
32	20	SP
33	21	!
34	22	"
35	23	#
36	24	$
37	25	%
38	26	&
39	27	'
40	28	(
41	29	)
42	2A	*
43	2B	+
44	2C	,
45	2D	-
46	2E	.
47	2F	/
48	30	0
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
58	3A	:
59	3B	;
60	3C	<
61	3D	=
62	3E	>
63	3F	?

Dec	Hex	Char
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
70	46	F
71	47	G
72	48	H
73	49	I
74	4A	J
75	4B	K
76	4C	L
77	4D	M
78	4E	N
79	4F	O
80	50	P
81	51	Q
82	52	R
83	53	S
84	54	T
85	55	U
86	56	V
87	57	W
88	58	X
89	59	Y
90	5A	Z
91	5B	[
92	5C	\
93	5D	]
94	5E	^
95	5F	_

Dec	Hex	Char
96	60	`
97	61	a
98	62	b
99	63	c
100	64	d
101	65	e
102	66	f
103	67	g
104	68	h
105	69	i
106	6A	j
107	6B	k
108	6C	l
109	6D	m
110	6E	n
111	6F	o
112	70	p
113	71	q
114	72	r
115	73	s
116	74	t
117	75	u
118	76	v
119	77	w
120	78	x
121	79	y
122	7A	z
123	7B	{
124	7C	|
125	7D	}
126	7E	~
127	7F	⌂

Dec	Hex	Char
128	80	Ç
129	81	ü
130	82	é
131	83	â
132	84	ä
133	85	à
134	86	å
135	87	ç
136	88	ê
137	89	ë
138	8A	è
139	8B	ï
140	8C	î
141	8D	ì
142	8E	Ä
143	8F	Å
144	90	É
145	91	æ
146	92	Æ
147	93	ô
148	94	ö
149	95	ò
150	96	û
151	97	ù
152	98	ÿ
153	99	Ö
154	9A	Ü
155	9B	ø
156	9C	£
157	9D	Ø
158	9E	×
159	9F	ƒ

Dec	Hex	Char
160	A0	á
161	A1	í
162	A2	ó
163	A3	ú
164	A4	ñ
165	A5	Ñ
166	A6	ª
167	A7	º
168	A8	¿
169	A9	®
170	AA	¬
171	AB	½
172	AC	¼
173	AD	¡
174	AE	«
175	AF	»
176	B0	▒
177	B1	▓
178	B2	│
179	B3	┤
180	B4	╡
181	B5	╢
182	B6	╖
183	B7	╕
184	B8	╣
185	B9	║
186	BA	╗
187	BB	╝
188	BC	╜
189	BD	╛
190	BE	┐
191	BF	└

Dec	Hex	Char
192	C0	┴
193	C1	┬
194	C2	├
195	C3	─
196	C4	┼
197	C5	╞
198	C6	╟
199	C7	╚
200	C8	╔
201	C9	╩
202	CA	╦
203	CB	╠
204	CC	═
205	CD	╬
206	CE	╧
207	CF	╨
208	D0	╤
209	D1	╥
210	D2	╙
211	D3	╘
212	D4	╒
213	D5	╓
214	D6	╫
215	D7	╪
216	D8	┘
217	D9	┌
218	DA	█
219	DB	▄
220	DC	▌
221	DD	▐
222	DE	▀
223	DF	α

Dec	Hex	Char
224	E0	ß
225	E1	Γ
226	E2	π
227	E3	Σ
228	E4	σ
229	E5	µ
230	E6	τ
231	E7	Φ
232	E8	Θ
233	E9	Ω
234	EA	δ
235	EB	∞
236	EC	φ
237	ED	ε
238	EE	∩
239	EF	≡
240	F0	±
241	F1	≥
242	F2	≤
243	F3	⌠
244	F4	⌡
245	F5	÷
246	F6	≈
247	F7	°
248	F8	∙
249	F9	·
250	FA	√
251	FB	ⁿ
252	FC	²
253	FD	■
254	FE	■
255	FF	