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UNIVERSITI SAINS MALAYSIA

First Semester Examination  
2015/2016 Academic Session

December 2015/January 2016

**CST131 – Computer Organisation**  
*[Organisasi Komputer]*

Duration : 2 hours  
*[Masa : 2 jam]*

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**INSTRUCTIONS TO CANDIDATE:**

*[ARAHAN KEPADA CALON:]*

- Please ensure that this examination paper contains **FOUR** questions in **NINE** printed pages before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi **EMPAT** soalan di dalam **SEMBILAN** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

- Answer **ALL** questions.

*[Jawab **SEMUA** soalan.]*

- You may answer the questions either in English or in Bahasa Malaysia.

*[Anda dibenarkan menjawab soalan sama ada dalam bahasa Inggeris atau bahasa Malaysia.]*

- In the event of any discrepancies, the English version shall be used.

*[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi bahasa Inggeris hendaklah diguna pakai.]*

1. (a) How did the development of the transistor affect computers? What did the transistor replace?

(5/100)

- (b) Consider two different implementations, M1 and M2, of the same instruction set. There are three classes of instructions (A, B, and C) in the instruction set. M1 has a clock rate of 80 MHz and M2 has a clock rate of 100 MHz. The average number of cycles for each instruction class and their frequencies (for a typical program) are as follows:

Instruction Class	Machine M1 – Cycles/Instruction Class	Machine M2 – Cycles/Instruction Class	Frequency
A	1	2	60%
B	2	3	30%
C	4	4	10%

- (i) Calculate the average Clock Per Instruction (CPI) for each machine, M1, and M2.
- (ii) Calculate the average Million Instructions Per Second (MIPS) ratings for each machine, M1 and M2.

(8/100)

- (c) Divide  $21_{10}$  by  $3_{10}$  using the unsigned binary division algorithm. For each of the cycles in the algorithm, show the values for Q (dividend), M (divisor), and A (additional) registers, and briefly describe each cycle. Use 5 bits to represent each number in twos complement.

(12/100)

2. (a) Using Boolean algebra and DeMorgan's theorems, simplify the following expression to include *two* literals.

$$A + B(C + \overline{A + C})$$

(5/100)

- (b) Simplify the following Boolean expression by means of a three variable Karnaugh map. Draw its logic circuit.

$$F(A, B, C) = \sum m(0, 3, 4, 5, 7)$$

(7/100)

- (c) Design a memory of size 1024 x 16 bit using 512 x 8 bit ROM chips with Enable input and a decoder. Draw the schematic diagram.

(7/100)

- (d) A 2-byte instruction is stored at location 50 with its address filed at location 51. The address filed has value 110. A processor register R1 contains value 125. Compute the effective address for each of the following addressing modes of the instruction:
- immediate addressing.
  - direct addressing.
  - relative addressing.
  - register indirect addressing.

(6/100)

3. (a) Based on Figure 1, explain the function of the following items:

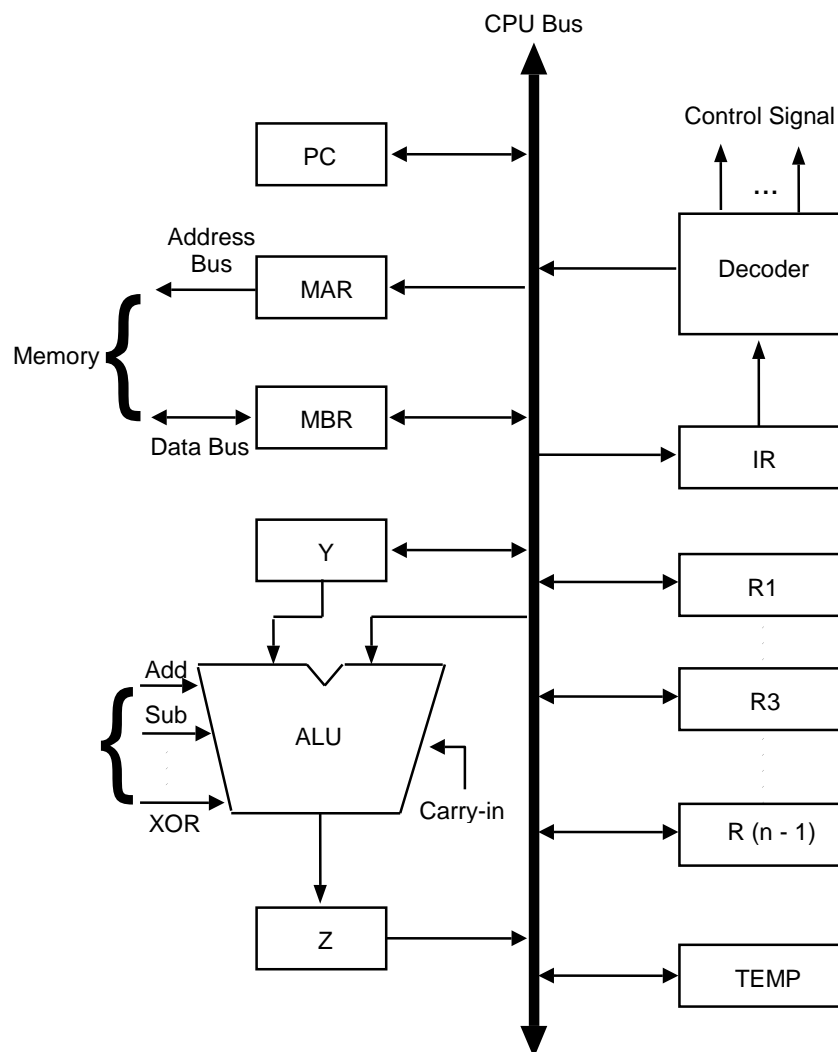


Figure 1

- (i) Memory address register (MAR).
- (ii) Memory buffer register (MBR).
- (iii) Program counter (PC).
- (iv) Arithmetic Logic Unit (ALU).
- (v) Data bus.

(10/100)

- (b) (i) What are the registers?
- (ii) There are **four (4)** main registers for instruction execution. List **three (3)** registers and explain the purpose of these registers.

(7/100)

- (c) Assume that a program has a sequence of 10 instructions streaming through an instruction pipeline with 4 stages. In this program, there is 20 percent chance of encountering a branch instruction. The probability that a branch is taken is 40 percent. Each stage of the pipeline requires one clock cycle. Note that when a branch is taken, the pipeline has to be cleared. Calculate the following:

- (i) Time taken to execute the program.
- (ii) Speedup factor of the pipeline.

(8/100)

4. (a) Write a series of micro-operations for the following:

- (i) Fetch cycle.
- (ii) Load Accumulator.
- (iii) Jump.

(6/100)

- (b) Explain **two (2)** differences between the following items:

- (i) Static RAM and dynamic RAM.
- (ii) Cache memory and virtual memory.

(6/100)

(c) A computer has 64MB main memory and 32KB cache memory. Each of the blocks in the cache memory can store 8 bytes. Show the main memory address using the following techniques:

- (i) Direct mapping
- (ii) Associative mapping
- (iii) 8-ways set associative mapping

(9/100)

(d) Explain **two (2)** advantages of direct memory access (DMA) compared to programmed I/O and interrupt I/O.

(4/100)

**KERTAS SOALAN DALAM VERSI BAHASA MALAYSIA**

[CST131]

- 6 -

1. (a) Bagaimanakah pembangunan transistor memberi kesan kepada komputer? Apakah yang transistor gantikan? (5/100)

- (b) Pertimbangkan dua pelaksanaan yang berbeza, M1 dan M2, untuk set suruhan yang sama. Terdapat tiga jenis kelas suruhan (A, B, dan C) di dalam set suruhan. M1 mempunyai kadar jam 80 MHz dan M2 mempunyai kadar jam 100 MHz. Purata kitar per suruhan untuk setiap set suruhan dan frekuensi (untuk program tipikal) adalah seperti berikut:

Kelas Suruhan	Mesin M1 – Kitaran/Kelas Suruhan	Mesin M2 – Kitaran/Kelas Suruhan	Frekuensi
A	1	2	60%
B	2	3	30%
C	4	4	10%

- (i) Kira purata *Clock Per Instruction* (CPI) untuk setiap mesin, M1, dan M2.  
(ii) Kira purata kadar *Million Instructions Per Second* (MIPS) untuk setiap mesin, M1 dan M2.

(8/100)

- (c) Bahagikan  $21_{10}$  dengan  $3_{10}$  menggunakan algoritma bahagi perduaan tanpa tanda. Tunjukkan nilai daftar untuk Q (dividen), M (pembahagi), dan A (tambahan) untuk setiap kitaran di dalam algoritma. Terangkan secara ringkas setiap kitaran. Gunakan 5 bit untuk mewakili setiap nombor dalam lengkapkan dua.

(12/100)

2. (a) Dengan menggunakan teknik aljabar Boolean dan teorem DeMorgan, permudahkan ungkapan berikut untuk mengandungi *dua* harafiah.

$$A + B(C + \overline{A + C})$$

(5/100)

- (b) Permudahkan ungkapan Boolean berikut melalui peta Karnaugh. Lukiskan litar logiknya.

$$F(A, B, C) = \sum m(0,3,4,5,7)$$

(7/100)

- (c) Reka bentukkan suatu ingatan 1024 x16 bit menggunakan cip-cip ROM 512 x 8 bit yang mempunyai pemboleh (*Enable*) dan satu penyahkod. Lakarkan gambar rajah skema.

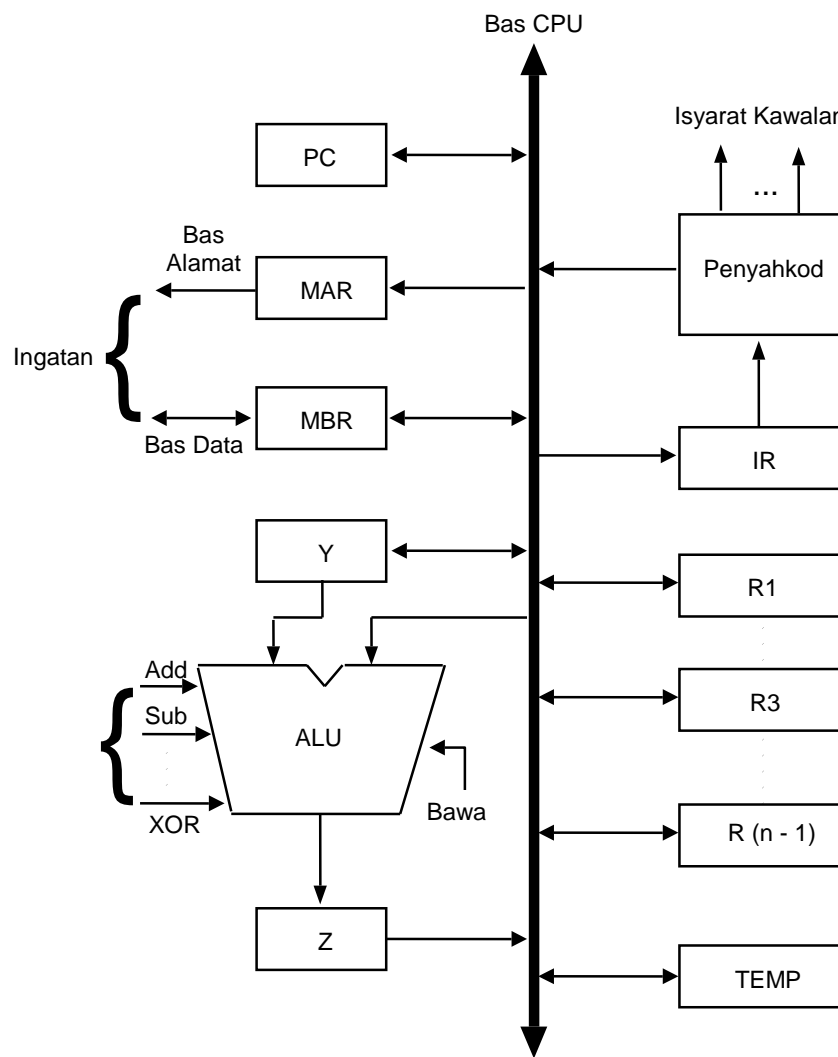
(7/100)

(d) Suatu arahan 2-bait disimpan pada alamat 50 dan medan alamatnya pada 51. Kandungan medan alamat adalah 110. Daftar pemproses R1 mengandungi 125. Kirakan alamat berkesan bagi setiap mod pengalamatan arahan yang berikut:

- (i) Pengalamatan serta merta.
- (ii) Pengalamatan terus.
- (iii) Pengalamatan relatif.
- (iv) Pengalamatan daftar tak langsung.

(6/100)

3. (a) Berdasarkan Rajah 1, terangkan fungsi bagi setiap item yang berikut:



Rajah 1

- (i) Daftar alamat ingatan (MAR).
- (ii) Daftar penimbal ingatan (MBR).
- (iii) Pembilang atur cara (PC).
- (iv) Unit Arimetik Logik (ALU).
- (v) Bas data.

(10/100)

- (b) (i) Apakah itu daftar?
- (ii) Terdapat **empat (4)** jenis daftar yang digunakan untuk melaksanakan arahan. Senaraikan dan terangkan fungsi **tiga (3)** daftar tersebut.

(7/100)

- (c) Andaikan suatu atur cara mengandungi 10 arahan berjujukan yang dilaksanakan melalui talian paip dalam 4 peringkat. Dalam atur cara ini, kebarangkalian menemui arahan cabang ialah 20 peratus. Kebarangkalian arahan cabang diambil ialah 40 peratus. Setiap peringkat talian paip memerlukan satu kitar jam. Ingat apabila cabang diambil, talian paip harus dikosongkan. Kira yang berikut:

- (i) Masa diambil untuk melaksanakan atur cara ini.
- (ii) Faktor kepantasan talian paip.

(8/100)

4. (a) Tulis siri mikro-operasi untuk yang berikut:

- (i) Kitar ambil.
- (ii) Muat penumpuk.
- (iii) Lompat.

(6/100)

- (b) Jelaskan **dua (2)** perbezaan antara pasangan berikut:

- (i) RAM statik dan RAM dinamik.
- (ii) Ingatan cache dan ingatan maya.

(6/100)



(c) Suatu komputer mempunyai 64MB ingatan utama dan 32KB ingatan cache. Setiap blok di dalam ingatan cache dapat menyimpan 8 bait. Tunjukkan format alamat ingatan utama menggunakan teknik-teknik pemetaan berikut:

- (i) Pemetaan terus
- (ii) Pemetaan berseketu
- (iii) Pemetaan 8-cara set berseketu

(9/100)

(d) Terangkan **dua (2)** kebaikan capaian ingatan secara terus (DMA) berbanding dengan I/O atur cara dan I/O sampukan.

(4/100)