UNIVERSITI SAINS MALAYSIA

First Semester Examination
2016/2017 Academic Session

December 2016 / January 2017

CST131 – Computer Organisation
[Organisasi Komputer]

Duration : 2 hours
[Masa : 2 jam]

INSTRUCTIONS TO CANDIDATE:
[ARAHAN KEPADA CALON:]

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

  *[Sila pastikan bahawa kertas peperiksaan ini mengandungi **EMPAT** soalan di dalam **ENAM** 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) What is a stored program computer?

Apakah atur cara tersimpan komputer?

(2/100)

(b) Briefly describe Moore's law.

Terangkan secara ringkas Moore's law.

(3/100)

(c) Without using a calculator, show 10011001.10_2 in the following formats. Show your workings.

Tanpa menggunakan kalkulator, tunjukkan 10011001.10_2 di dalam format-format berikut tanpa menggunakan kalkulator. Tunjukkan jalan kerja.

(i) Octal.

Nombor perlapanan.

(ii) Hexadecimal.

Nombor perenambelasan.

(6/100)

(d) Multiply -15_{10} by -3_{10} using Booth's algorithm for twos-complement multiplication. For each cycle in the algorithm, show the values for the required registers. Briefly describe each cycle.

Darabkan -15_{10} dengan -3_{10} menggunakan algoritma Booth untuk pendaraban pelengkap dua. Untuk setiap kitaran algoritma, tunjuk nilai-nilai daftar yang diperlukan. Terangkan secara ringkas untuk setiap kitaran.

(14/100)

2. (a) Using Boolean algebra techniques, simplify the following expressions.

Permudahkan ungkapan-ungkapan berikut menggunakan teknik-teknik aljabar Boolean.

(i) $(A' + B)\ (A + B)$

(ii) $(A + B)\ (A + C)$

(8/100)

(b) Distinguish between combinational logic circuits and sequential logic circuits.

Bezakan di antara litar logik gabungan dan litar logik berjujukan.

(4/100)

(c) A staircase light is controlled by two switches S1 and S2, one at the top of the stairs and another at the bottom of stairs.

Lampu tangga dikawal oleh dua suis, S1 dan S2, satu bahagian atas tangga dan satu lagi bahagian bawah tangga.

(i) Produce a truth table for this system.

Hasilkan jadual kebenaran untuk sistem ini.

(ii) Write the logic equation in SOP form.

Tulis persamaan logik di dalam bentuk SOP.

(iii) Design the circuit using AND-OR gates.

Reka litar menggunakan AND-OR 'gates'.

(8/100)

(d) Using one-address instructions, write a program to compute $X = A – B \times C$.

Menggunakan suruhan satu alamat, tulis atur cara untuk mengira $X = A – B \times C$.

(5/100)

3. (a) An instruction is stored at location 652 with its address field at location 653. The address field has the value 700. A processor register R3 contains the number 400. Evaluate the effective address if the address mode of the instruction is:

Suatu arahan disimpan di lokasi 652 mempunyai medan alamat di lokasi 653. Medan alamatnya bernilai 700. Suatu daftar pemproses R3 mengandungi nombor 400. Nilaikan alamat berkesan jika mod alamat arahan ialah:

(i) Direct.

Terus.

(ii) Immediate.

Segera.

(iii) PC Relative.

PC relatif.

(iv) Register indirect.

Daftar Tidak Langsung.

(v) Index with R3 as the index register.

Indeks R3 sebagai Daftar Indeks.

(6/100)

(b) Assume a pipeline with 5 stages: Fetch Instruction (FI), Decode Instruction(DI), Calculate Address (CA), Fetch Operand (FO), and Execute (EX). Draw a timing diagram for a sequence of instruction (I1, I2, I3, I4, I5, I6, and I17), in which I4 is a branch instruction to I17 that is taken and in which there are no data dependencies.

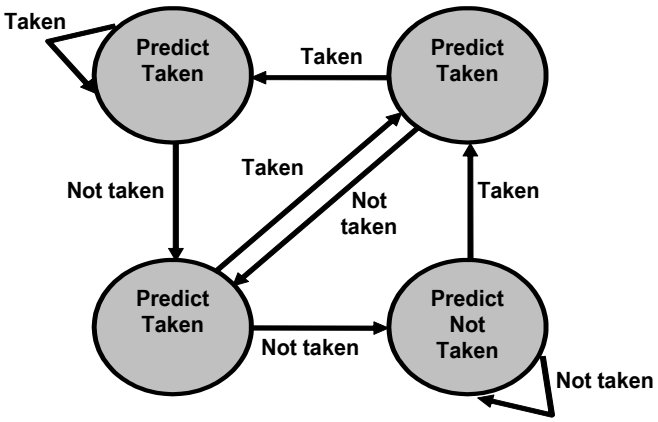
Andaikan sebuah saluran paip lima peringkat : Capai Arahan (FI), Dekod Arahan (DI), Kira Alamat (CA), Capai Operan (FO) and Laksana (EX). Lakarkan rajah pemasaan untuk turutan arahan (I1, I2, I3, I4, I5, I6, and I17), di mana I4 ialah arahan cabang yang ke I17 yang diambil dan tiada kebergantungan data.

(7/100)

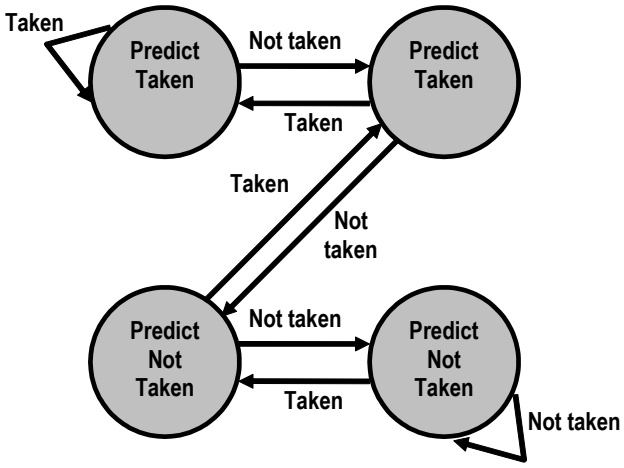
(c) Describe the behaviour of the following branch prediction state diagram:

Huraikan perilaku setiap gambar rajah keadaan ramalan cabang berikut:

(i)



(ii)



(6/100)

(d) Consider the internal structure of a CPU consisting of a program counter (PC), instruction register (IR), memory address register (MAR), memory buffer register (MBR), accumulator (AC), arithmetic and logic unit (ALU), control unit, and 3 additional registers X, Y, and Z (temporary storage). Write the sequence of micro-operations required to add a number to the AC when the number is

Pertimbangkan struktur dalaman CPU terdiri daripada kaunter program (PC), arahan daftar (IR), alamat ingatan daftar (MAR), ingatan penimbal daftar (MBR), accumulator (AC), aritmetik dan unit logik (ALU), kawalan unit, dan 3 daftar tambahan X, Y, dan Z (penyimpanan sementara). Tuliskan turutan mikro-operasi yang diperlukan untuk menambah satu nombor ke AC

(i) an immediate operand.

sebuah operan segera.

(ii) a direct-address operand.

sebuah operan terus.

(6/100)

4. (a) Explain **three** (**3**) differences between a horizontal and vertical microarchitecture.

*Terangkan **tiga** (**3**) perbezaan di antara microarchitecture mendatar dan menegak.*

(6/100)

(b) 256 words need to be transferred from a magnetic disk to a memory section starting from address 1890. The transfer is via DMA. Give the initial values that the CPU must transfer to the DMA controller.

256 perkataan perlu dipindahkan dari cakera magnet ke bahagian ingatan bermula dari alamat 1890.Pemindahan itu adalah melalui DMA. Beri nilai awal CPU yang mesti dipindahkan kepada pengawal DMA itu.

(4/100)

(c) Assume a control memory is 40 bits wide. The microinstruction format is divided into 3 fields:

Andaikan memori kawalan mempunyai kelebaran 40 bit. Format mod arahan dibahagikan kepada 3 medan:

- Micro-operation field: 18 bits.
  Medan mikro operasi: 18 bit.

- Address selection field: 24 flags
  Medan pilihan alamat: 24 bendera.

- Address field.
  Medan alamat.

(i) How many bits are in the address selection field?

Berapakah bilangan bit dalam medan pemilihan alamat?

(ii) How many bits are in the address field?

Berapa banyak bit dalam medan alamat?

(iii) What is the size of the control memory (in bytes)?

Apakah saiz memori kawalan (dalam bait)?

(5/100)

(d) A computer machine with a byte addressable main memory of 2^{16} bytes. Each block is 4 bytes in length. Assume that the machine's cache has 16 lines and the mapping function used is direct mapping.

Satu mesin komputer mempunyai unit ingatan utama 2^{16} bait. Panjang setiap blok ialah 4 bait. Andaikan cache mesin tersebut mempunyai saiz talian 16 garisan dan pemetaan yang digunakan adalah pemetaan terus.

(i) How is the memory address divided into tag, line number, and byte number?

Bagaimana alamat memori tersebut dibahagikan kepada tag, nombor garisan dan nombor bait?

(ii) List **six** (**6**) design elements to classify and differentiate cache architectures.

*Senaraikan **enam** (**6**) elemen reka bentuk untuk mengelaskan dan membezakan seni bina cache.*

(10/100)