

Mid-Semester Examination
School of Computer Engineering
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Time: 1hrs 30 Minutes**Full Mark:20***(Answer any four questions including question No.1 which is compulsory.**The figures in the margin indicate full marks)***1) Short Questions****[1 × 5]**

- a) Let a processor operates by a frequency 20MHz and it executes a program having 200 instructions out of which 50% are register referenced instructions, 30% are memory reference instructions and 20% are branch instructions. The register referenced instruction, memory reference instruction and branch instruction will take 4, 8 and 6 clock cycles respectively, then find out the total time required by the processor to execute the program.
- b) There are two eight bit register 'R1' and 'R2' contains the values -5 and -125 respectively. Find out the values of the status bits of V(overflow), S(sign), Z(zero), C(carry) flags when the following instruction is executed.
 ADD R1, R2
- c) Consider a processor with 64 registers that supports twelve instructions. Each instruction has five distinct fields, namely, opcode, two source register fields, one destination register field, and a twelve-bit immediate value. Each instruction must be stored in memory in a byte-aligned fashion. If a program has 100 instructions, What is the amount of memory (in bytes) consumed by the program?
- d) Differentiate between big endian and little endian scheme.
- e) The content of register R1 is 10110011. What will be the decimal value after execution of following instruction. [Assume the number is represented in 2's complement format]

AShiftL #2, R1

2)**[3+2]**

- a) Write the assembly code to evaluate the following arithmetic expression:

$$Z = (5(P + Q) * (R * S / T)) / X$$
 - i) Using an general organization type computer with two address instructions.
 - ii) Using an accumulator type computer with one address instructions.
 - iii) Using a stack organized computer with zero-address operation instructions.
- b) Draw the schematic diagram of single bus CPU organization, clearly explaining each components of CPU such as general purpose, special purpose registers and the data paths. Explain the function of each of its components.

3)**[3+2]**

- a) Write the sequence of control steps for the following instructions for single bus CPU organization. Assume second operand is the destination operand.
 DIV 50(R1, R2), R3
- b) Discuss the functionality of two data transfer instructions and two data manipulation instructions with examples.

- 4) [3+2]
- a) A two word instruction LOAD is stored at location 1000 with its address field at location 1001. The address field has the value 2000 and the value stored at 2000 is 5000 and at 5000 is 6500. The words stored at 2200, 3002 are 3500, 4000 respectively. An index register has value 200. Evaluate the effective address and operand if addressing mode of the instruction is as follows:
- I. Memory Indirect Addressing Mode
 - II. Relative Addressing Mode
 - III. Index Addressing Mode
- b) Write the sequence of control steps for the following instruction for three bus CPU organization, where R3 is the destination register.
- ADD -(R1), R2, R3

- 5) [3+2]
- a) Suppose you want organize a nested subroutine call for which all the instructions and its corresponding memory addresses are given below. Here, the main program makes a subroutine call named 'SUB1' and SUB1 subroutine makes another subroutine call named 'SUB2'. The content of the stack pointer (SP) and top of the memory stack (ToS) is 4000 and 5000 respectively.

Main Program		SUB 1(First Subroutine)		SUB2 (Second Subroutine)	
Addresses	Instructions	Addresses	Instructions	Addresses	Instructions
1000	ADD R1, R2	2000	SUB R0, R3	3000	MUL R4, R5
1004	CALL SUB1	2004	CALL SUB2	3004	DIV R5, R6
1008	SUB R3, R2	2008	MUL R6, R3	3008	RETURN
1012	RETURN	2012	RETURN		

What is the content of PC, SP, and ToS for the followings.

- I. After the subroutine call instruction is executed in the main program?
 - II. After the subroutine call instruction is executed in the subroutine SUB1?
 - III. After return from the subroutine SUB2?
- b) Draw and explain the block diagram and working principle of the hardwired control unit. Describe the functions of each of its components.