Motilal Nehru National Institute of Technology Allahabad
Department of Computer Science and Engineering
Subject: Computer Organization
Mid Semester Exam
BTech (IT) 4th Semester
1.5 Hrs..; Max. Marks: 20

Notes: Attempt all questions

1. (4) Consider two different implementations, P1 and P2, of the same instruction set. There are five classes of instructions (A, B, C, D, and E) in the instruction set. The clock rate and CPI of each class is given below.

S.No.	Clock Rate	CPI Class A	CPI Class B	CPI Class C	CPI Class D	CPI Class E
P1	2.0 GHz	1	2	3	4	3
P2	4.0 GHz	2	2	2	4	4

(a) Assume that peak performance is defined as the fastest rate that a computer can execute any instruction sequence. What are the peak performances of P1 and P2 expressed in instructions per second?
(b) If the number of instructions executed in a certain program is divided equally among the classes of instructions except for class A, which occurs twice as often as each of the others, which computer is faster? How much faster is it?
(c) If the number of instructions executed in a certain program is divided equally among the classes of instructions except for class E, which occurs twice as often as each of the others, which computer is faster? How much faster is it?

2. (6) Consider the following Array code in C:

```
void shift(int a[], int n){
int i;
for(i=0;i!=n-1;i++)
a[i]=a[i+1];
}
```

(a) Translate this function into MIPS assembly.
(b) Convert this function into pointer-based code (in C).
(c) Translate your pointer-based C code from (b) into MIPS assembly.
(d) Compare the number of temporary registers (t-registers) needed for your array-based code from (a) and for your pointer-based code from (b).
(e) What other merits or demerits you can think of in pointer based assembly code compared to array based assembly code.

3. (6) Consider the following C code:

```
int fib(int n){
      if (n==0)
            return 0;
      else if (n == 1)
            return 1;
      else
      fib(n-1) + fib(n-2);
      }
```

(a) Draw the control flow graph of the above code taking n=3.
(b) Implement the C code in the table in MIPS assembly. What is the total number of MIPS instructions needed to execute the function?
(c) For each function call, show the contents of the stack at every step when the function calls/returns happen taking n=4. Assume the stack pointer is originally at address 7ffffffc $_{Hex}$.

4. (2) Consider the following MIPS code with corresponding machine code in respective instruction format where field values are shown in decimal. What decimal values should be there in place of question mark sign?

```
Loop: sll  $t1, $s3, 2      40000
      add  $t1, $t1, $s6    40004
      lw   $t0, 0($t1)      40008
      bne  $t0, $s5, Exit   40012
      addi $s3, $s3, 1      40016
      j    Loop             40020
Exit: …                     40024
```

0	0	19	9	4	0	
0	9	22	9	0	32	
35	9	8	0			
5	8	21	?			
8	19	19	1			
2	?					

5. (2) Provide example instructions for the following MIPS addressing modes:
(a) Immediate addressing mode
(b) Base addressing mode for byte, half word and word
(c) PC-relative addressing mode
(d) Pseudo direct addressing mode

OR

(2) Explain the following with MIPS instructions:
a. Branching far away within program
b. Using 32 bit constants.