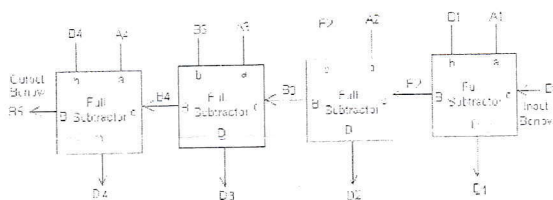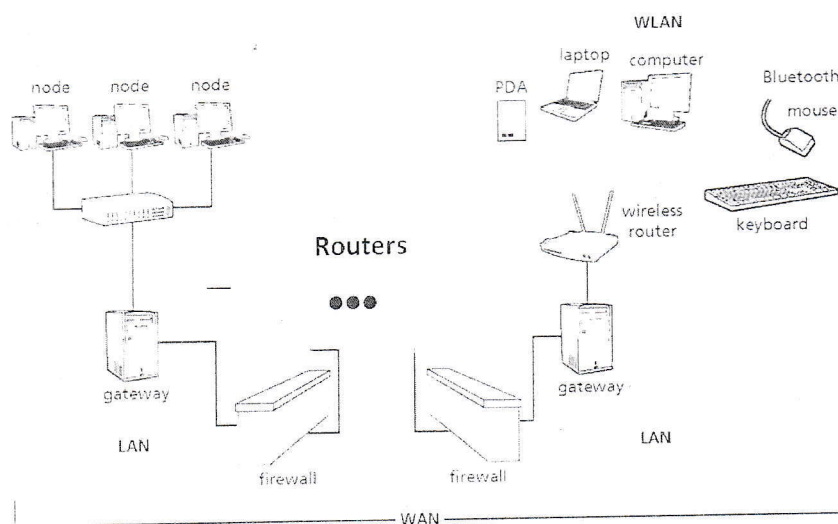I. Please draw a complete Von Neumann computer architecture with all three types of buses and explain the functionality of each components. (20%)

II. Modern computers store machine code programs in the main memory of the computers, please describe in detail the machine cycles by which a CPU executes the programs. (give the name of the cycle first and then describe all the 5 phases) (20%)

III. Please explain these terms in detail, for (a) to (c) please give the full name of each term first: (a) **BIOS** and **DOS** (b) **DRAM** and **SRAM** (c) **TCP protocol** (d)Time sharing (e) **Compiler** and **Interpreter** (f) **FDM** and **TDM** (20%)

IV. Except by using an adder and a 2's complementor to design a subtractor, one way to design a full subtractor is similar to design a full adder. (20%)

a. Complete the truth table of a one-bit full subtractor shown as below.

b. Please design the circuit from the truth table using appropriate gates (OR, AND, NOT, XOR). (using fewer gates gets higher grade)

Inputs			Outputs	
B_{in}	A	B	D	B_{out}
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		
$A - B - B_{in}$			Difference	Borrow out

V. The following figure shows the typical network elements that support the operations of the Internet. Please describe the functions of the following elements: LAN, WLAN, gateway, firewall, and routers. (20%)