Project Topics for B.Tech CSE AI (2023-2027)

22AIE102 -Elements of Computing Systems-1

Part A (compulsory for all teams)

- **Design and implement 16-bit HACK CPU (common to all groups)**

  - As a part of this project, the team is expected to study the architecture of a general-purpose central processing unit and how it can be programmed/implemented in hardware description language.

  - The design of all the constituent elements such as logic gates, multiway chips, Multiplexers, Adders, Program counter, Register, etc, must be made from NAND gates. (Hierarchical design is allowed, ie, if you have made basic AND, OR and NOT gates using NAND gates, you can use that to build all the chips in the design of CPU)

  - The implementation must be shown in the Hack Platform. Moreover, the CPU built must be shown as a part of the Hack computer

Part B (specific to a Team)

As a part of this project, the team is expected to study the design of the digital logic systems and how it can be programmed/implemented in hardware description language

1	Design and implement a digital system that takes the Gray code output from a rotary encoder and displays the rotary shaft's position on a 7-segment display
2	Design and implement a 4 -bit shift register (Serial In Serial Out) to store and retreive BCDs
3	Design and implement a circuit that performs binary multiplication on two 4-bit binary numbers
4	Design and implement a synchronous counter that count down from decimal digit 9 onwards to 0
5	Design and implement 16-bit carry-select adder with a uniform block size of 4
6	Design and implement 16-bit carry-select adder with variable size (block sizes of 2-2-3-4-5)
7	Design and implement 4-bit ring counter and Jhonson counter
8	Design and Implement 4-bit Universal Shift register using D Flip flops
9	Design and implement a 16-bit parallel adder/subtractor (a circuit which can perform both operation)
10	Design and Implement a 2-bit Serial Binary Adder using an SR flip flop
11	Design and implement a 8-bit Barrel Shifter
12	Design and implement a 5-bit even parity generator and checker
13	Design and implement a circuit that compares two 4-bit numbers and provides outputs indicating their relative magnitudes
14	Design and Implement a circuit which can perform multiplication by repeated addition
15	Design and Implement a modulo-1000 counter using decade counters
16	Design and Implement a Sequence detector which detect bit pattern "0110'
17	Design and implement a synchronous BCD counter using JK flip flop
18	Design and Implement digital clock using D-FFs which can show time up to one minute
19	Design and implement synchronous UP/DOWN counter circuit using JK Flip flops (up counting from 0 to 15 and down-counting 15 to 0 based on a control input)

Instructions

- The basic implementation must be shown in the Hack Platform. Built-in chips should not be used in any implementations except the D-flip flop. However, improvisation/creativeness in any other platforms like CircuitVerse, Falstad, etc is allowed.