

# **DIGITAL ELECTRONICS (BCA 103)**

**DEPARTMENT OF COMPUTER SCIENCE  
PROGRAMME: BCA**



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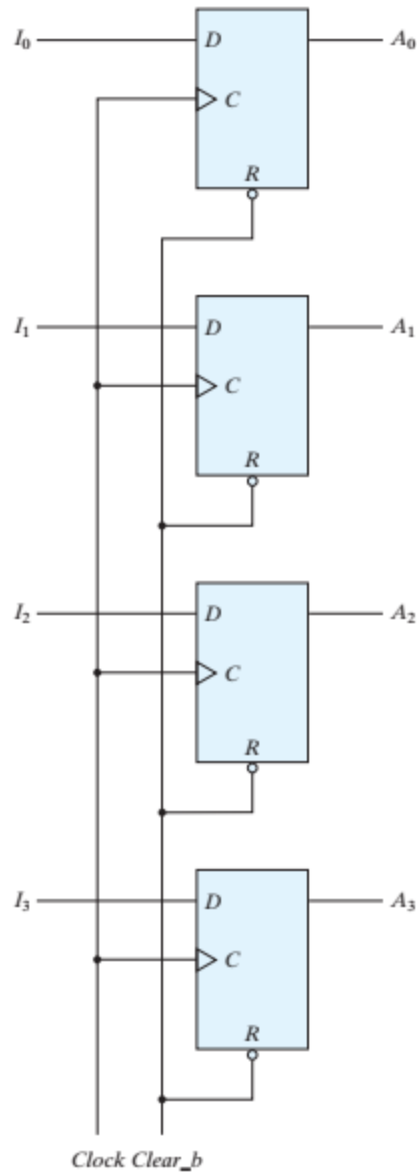
# REGISTERS

- Circuits that include flip-flops are usually classified by the function they perform rather than by the name of the sequential circuit.
- Two such circuits are **registers** and **counters**.
- A **register** is a group of flip-flops, each one of which shares a common clock and is capable of storing one bit of information.
- An  **$n$ -bit** register consists of a group of  **$n$  flip-flops** capable of storing  $n$  bits of binary information.
- In addition to the flip-flops, a register may have combinational gates that perform certain data-processing tasks.
- A register consists of **a group of flip-flops together with gates** that affect their operation.
- The **flip-flops** hold the **binary information**, and the **gates** determine **how the information is transferred into the register**.

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- A *counter* is essentially a register that goes through a predetermined sequence of binary states.
- The gates in the counter are connected in such a way as to produce the prescribed sequence of states.

# Four-bit Register



- The register is used to perform different types of operations.
- For performing the operations, the CPU use these registers.
- **i) Fetch:** It is used
  - To take the instructions given by the users.
  - To fetch the instruction stored into the main memory.
- **ii) Decode:**
  - The decode operation is used to interpret the instructions.
  - In decode, the operation performed on the instructions is identified by the CPU.
- **iii) Execute:**
  - The execution operation is used to store the result produced by the CPU in to the memory.
  - After storing this result, it is displayed on the user screen.
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# Types of Registers

- **1. Accumulator:**
- This is the most frequently used register used to store data taken from memory.
- The accumulator register has a very important role as if it is not there then all the intermediate results need to be stored in the main memory that can increase the overhead on the memory.
- It is because then unnecessary read and writes operations will be increased.
- The accessing speed of the accumulator register is much faster compared to the main memory.
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- **2. Program Counter (PC):**
- The other name for the program counter register is instruction address register (IAR) or IC (instruction counter).
- Program Counter (PC) is used to keep the track of execution of the program.
- It contains the memory address of the next instruction to be fetched.
- PC points to the address of the next instruction to be fetched from the main memory when the previous instruction has been successfully completed.
- Program Counter (PC) also functions to count the number of instructions.
- The incrementation of PC depends on the type of architecture being used.

- **3. Memory Address Registers (MAR):**
- The memory address register issued to fetch the instructions and data from the memory and helps to execute the instructions.
- The memory address register stores the address so that data can be easily fetched from the register.
- The memory address register is mainly used for reading and writing operation of data from memory.
- At the time of reading operation, the address is fetched from register to access the data, and then this data is fed into other types of registers known as memory data register (MDR).
- In the writing operation, the data is fetched from the memory data register (MDR) and stored at the address located by the memory address register.
- The memory address register always stores the address of the next location where data related operation will be executed.



- **4. Memory Data Registers (MDR):**
- The memory data register is used to store the data that will be stored or will be fetched from the computer memory i.e. Random-access Memory (RAM).
- The main use of the memory data register is to act as a buffer as it can store anything that can be copied from the computer memory and can be used by the processor for further operations.
- The memory data register stores the data before the data is transferred to the decoder.
- There are two types of registering in the memory data register.
- When the data is fetched from the memory and copied to the MDR the information is stored in one single direction and the data is written by other CPU registers that store data in computer memory.
- The other use of the memory data register is to store the data and information that can be shifted to other memory components of the system or vice versa.

- **5. Memory Buffer Register(MBR):**
- The memory buffer register is used to store information and data that can be read or write in the computer memory.
- The main function of the memory buffer register is to store various types of computer instructions and data that can be transferred between computer memory.

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- **6. Index Register(IR):**

- It is widely used for altering the address of operand at the time of program execution.
- The index register is widely used for doing array or vector operations.
- The content is fetched from the index register and added or subtracted to some immediate address to obtain an effective address of data.
- The index register working can be tested by special instruction and mainly used for testing the loop instructions.
- The index register can be used in the indirect addressing in which the modification is required for the address of the instruction.
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- **7. Instruction Register (IR):**
- The **IR** holds the instruction which is just about to be executed.
- The instruction from **PC** is fetched and stored in **IR**.
- As soon as the instruction is placed in **IR**, the CPU starts executing the instruction and the **PC** points to the next instruction to be executed.
- **8. General Purpose Registers:**
- These are numbered as  $R_0, R_1, R_2, \dots, R_{n-1}$ , and used to store temporary data during any ongoing operation.
- Its content can be accessed by assembly programming.

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