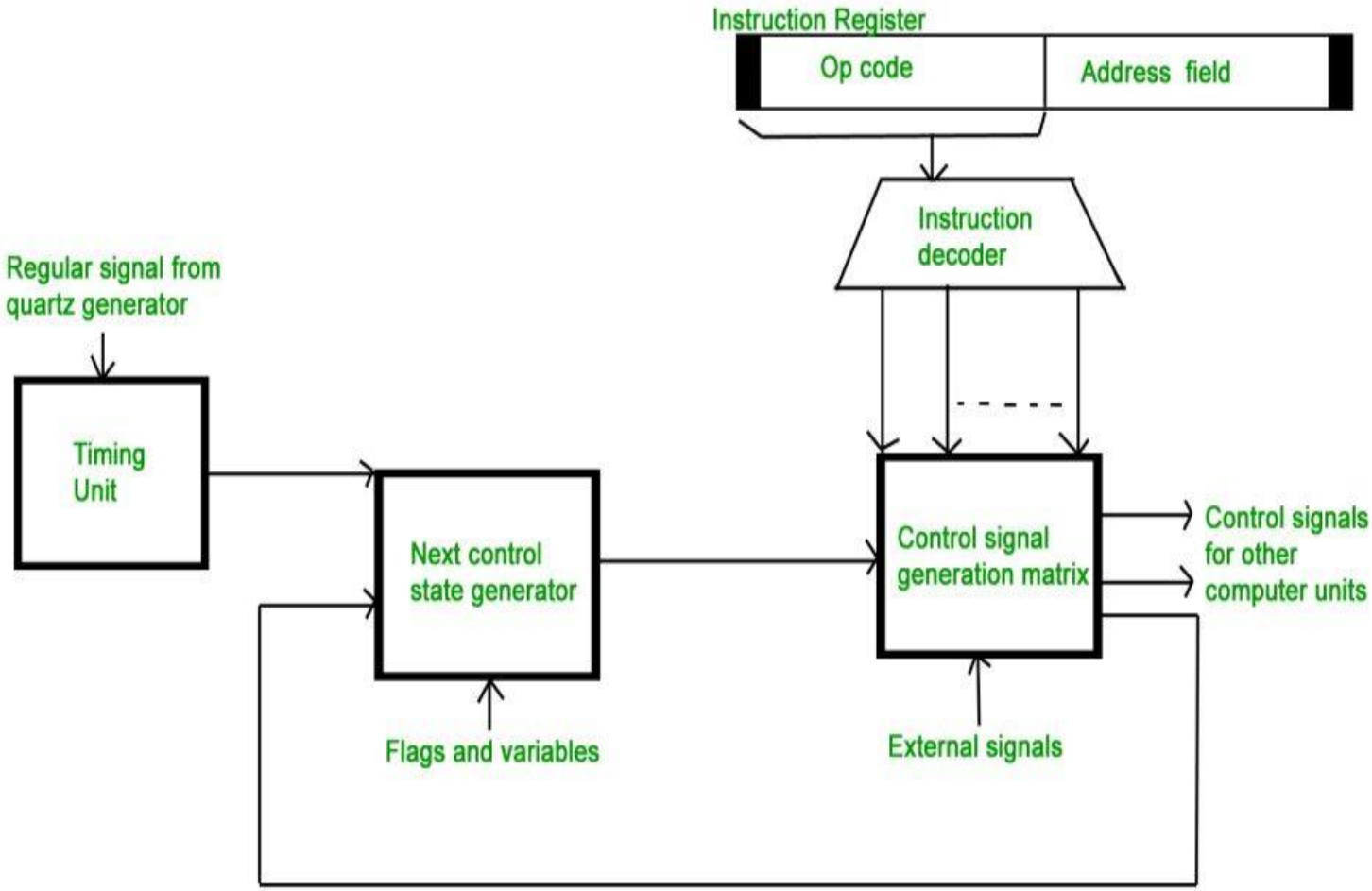
Hardwired & Micro-programmed Control Unit

- To execute an instruction, the control unit of the CPU must generate the required control signal in the proper sequence.
- There are two approaches used for generating the control signals in proper sequence as:

  1. Hardwired Control unit
  2. Micro-programmed control unit.

Hardwired Control Unit

- The control hardware can be viewed as a state machine that changes from one state to another in every clock cycle, depending on the contents of the instruction register, the condition codes and the external inputs.
- The sequence of the operation carried out by this machine is determined by the wiring of the logic elements and hence named as “hardwired”.


Instruction Register
Op code
Address field
Instruction decoder
Regular signal from quartz generator
Timing Unit
Next control state generator
Control signal generation matrix
Control signals for other computer units
Flags and variables
External signals

- Hardwired control unit components: gates, flip-flops, decoders, etc.
- It is faster than micro control unit.
- Preferred in RISC .

- Advantages:
  - It is fast .control signals are generated by combinational circuits.
  - Performance is high.

- Disadvantages:
  - Requires complex CPU signal
  - Difficult to modify the control signal.
  - Difficult to correct the mistakes and also difficult to add new features.

- Fixed logic circuits that correspond directly to the Boolean expressions are used to generate the control signals.
- Hardwired control is faster than micro-programmed control.
- A controller that uses this approach can operate at high speed.

Micro-programmed Control Unit

- Uses the sequence of microinstruction in microprogramming language.
- It is midway between hardware and software.
- Generates set of control signals on the basis of control lines.
- It is easy to change design, test and implement.
- Flexible to modify.

Micro-programmed Control Unit

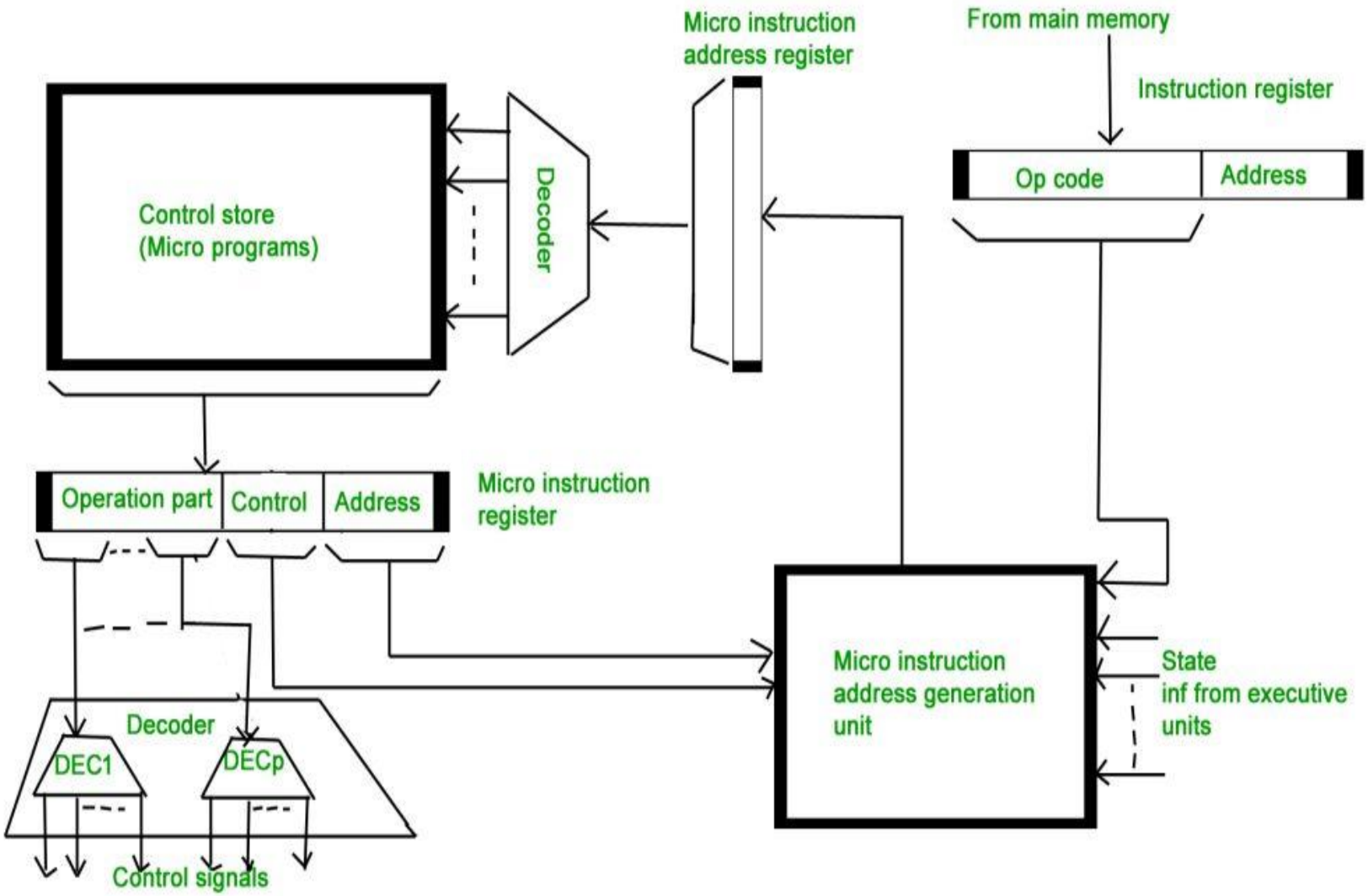
It consist of

control signal

- Control variables
- Control word
- Control memory
- Microinstruction
- Microprogram

Micro-programmed Control Unit

- Control signal comprises of group of bits used to select the path to decoder ,multiplexer ,ALU.
- Control variables defines the binary variable
- Control word is string of 1’s and 0’s to represent control variable.
- Control memory content control word.
- Microinstruction specifies the control signals for execution of micro operation.
- Micro program contains the sequence of microinstruction.


Micro instruction address register
From main memory
Instruction register
Op code
Address
Control store (Micro programs)
Decoder
Operation part
Control
Address
Micro instruction register
Micro instruction address generation unit
State inf from executive units
Decoder
DEC1
DECp
Control signals

- **Types of Micro-programmed Control Unit –** Based on the type of Control Word stored in the Control Memory (CM), it is classified into two types :

  1. **Horizontal Micro-programmed control Unit**
  2. **Vertical Micro-programmed control Unit**

1. Horizontal Micro-programmed control Unit :

- It supports longer control word.
- It is used in parallel processing applications.
- It allows higher degree of parallelism
- It requires no additional hardware(decoders). It means it is faster than Vertical Micro programmed.

2. Vertical Micro-programmed control Unit :

- It supports shorter control words.
- It supports easy implementation of new control signals therefore it is more flexible.
- It allows low degree of parallelism i.e., degree of parallelism is either 0 or 1.
- Requires an additional hardware (decoders) to generate control signals, it implies it is slower than horizontal micro programmed.