

Summary of Important Items to Understand Chapters 4 and 5

1. Instruction Cycle
 - Machine cycles
 - Instruction fetch
 - Memory read
 - Memory write
 - Execute
 - Interrupt acknowledge
 - Others
 - Micro-operations
2. Detailed consideration of the role of the special-purpose registers
 - Program counter
 - Stack pointer
 - Memory address register
 - Memory data register
 - Instruction register
3. Organization of CPU hardware
 - Internal bus
 - Concept of control signals
4. Basic operations within CPU
 - Instruction fetch
 - Reading data from memory
 - Writing data to memory
 - Register to register transfers
 - Instruction execution
5. Timing issues
 - T states
 - Effect of propagation delay
 - Effect of setup and hold times
6. Execution of a complete instruction
 - Sequencing of control actions
 - Instruction fetch
 - Incrementing the PC
 - Data fetch
 - Instruction execution
 - Data store
7. Control unit design choices
 - Hardwired control
 - Microprogrammed control
8. Hardwired control unit organization
 - Control step counter

- Step decoder
 - Instruction decoder
 - Control signal generation
9. Microprogrammed control units
- Microprogram counter (control address register - CAR)
 - Microprogram memory (control store)
 - Control buffer register
 - Organization of a microprogrammed control unit (hardware block diagram)
 - Sequencing of control words
 - Organization of control memory (what it contains)
 - Basic operations performed by a microprogrammed control unit
10. Microinstruction formats
- Horizontal microprogramming
 - Vertical microprogramming
 - Direct encoding
 - Indirect encoding
 - Advantages and disadvantages of each approach
11. Next microinstruction address generation
- Two address fields in the microinstruction
 - One address field in the microinstruction
 - A variable field in the microinstruction
 - Incrementation of the current address
12. Pipelining
- Concept of an n-stage pipeline
 - Pipeline bandwidth
 - Pipeline latency