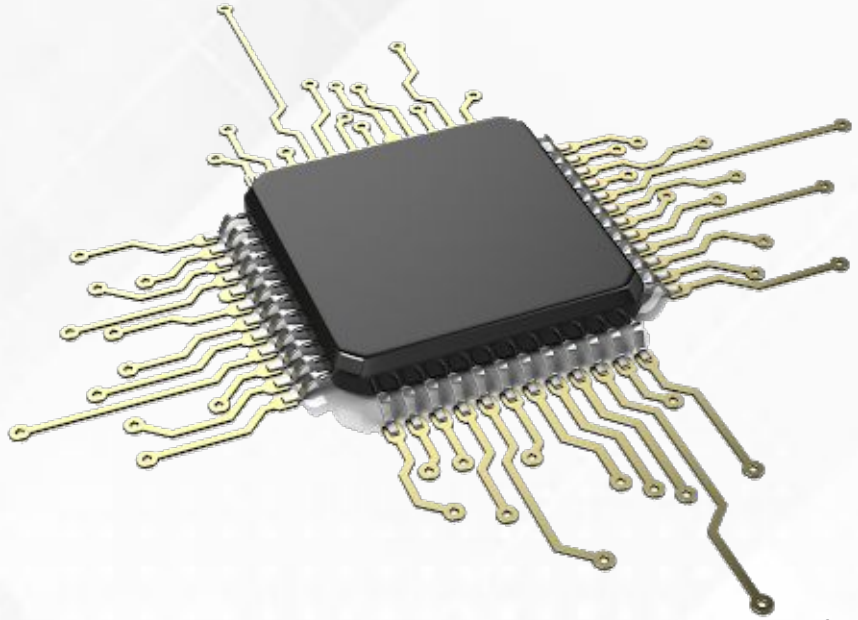
Computer Organization & Architecture
(COA)
GTU # 3140707

Dedicated Faculty, Committed Education
Darshan
Institute of Engineering & Technology

Unit-4
Microprogrammed Control



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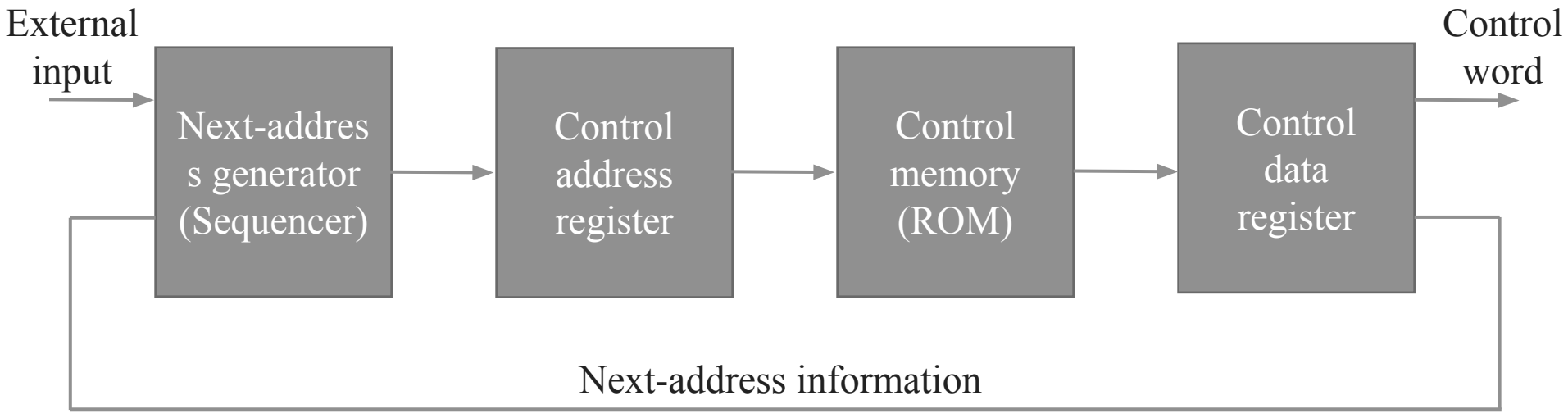
Outline

- Control Memory
- Address Sequencing
- Microinstruction Code Format
- Questions asked in GTU exam

Control Memory

Section - 1

Microprogrammed Control Organization



Control Memory

- A computer that employs a microprogrammed control unit will have two separate memories: a main memory and a control memory.
- The control memory holds a fixed microprogram that can not be altered by the occasional user.
- The microprogram consists of microinstructions that specify various internal control signals for execution of register microoperation.
- Microinstructions generates the microoperations to fetch instruction from main memory; to evaluate the effective address, to execute the operation specified by the instruction, and to return control to the fetch of next instruction.

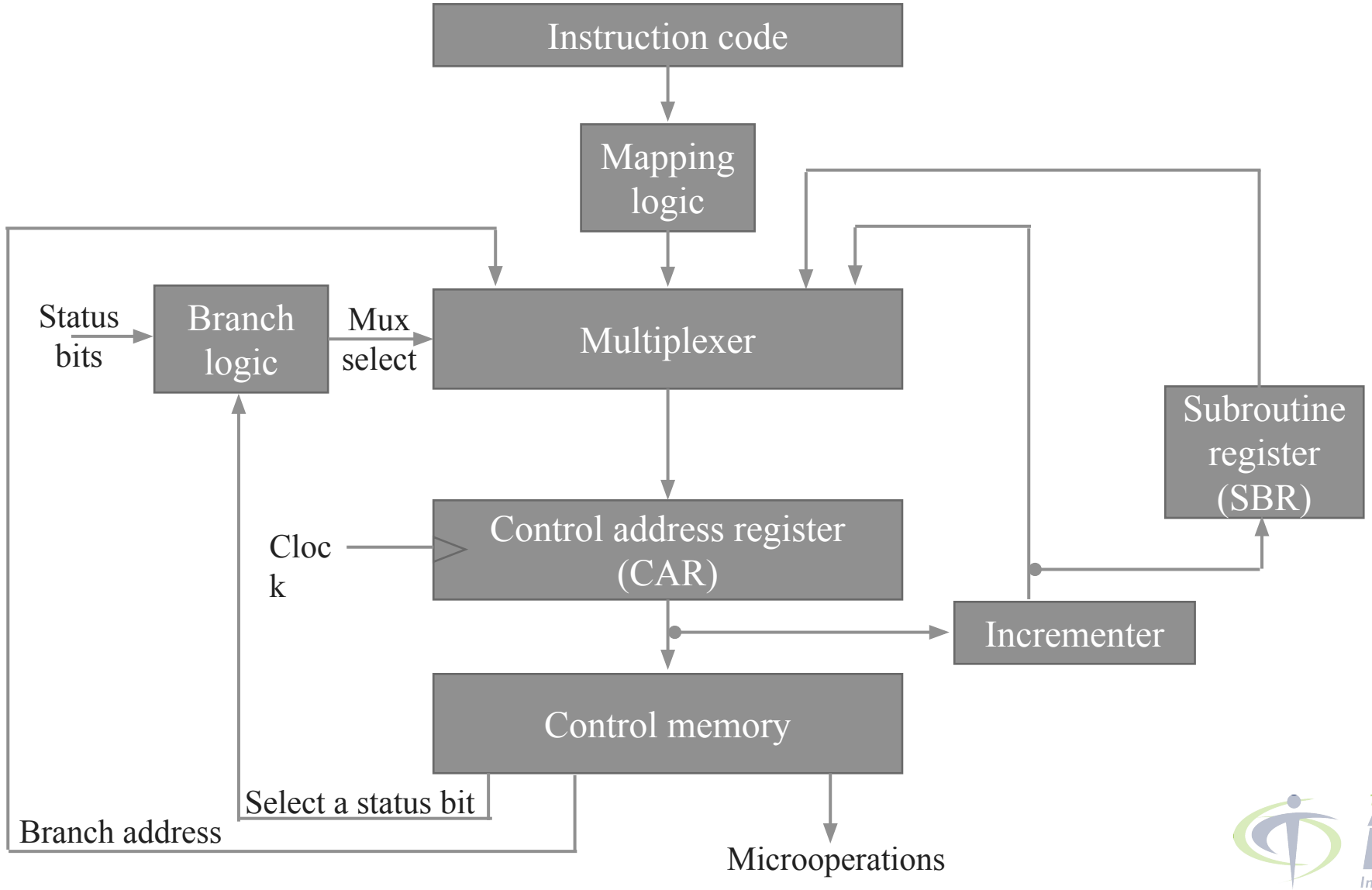
Address Sequencing

Section - 2

Address Sequencing

- Microinstructions are stored in control memory in groups, with each group specifying a *routine*.
- The transformation from the instruction code bits to an address in control memory where the routine is located is referred to as a *mapping* process.
- The address sequencing capabilities required in a control memory are:
  1. Incrementing of the control address register.
  2. Unconditional branch or conditional branch, depending on status bit conditions.
  3. A mapping process from the bits of the instruction to an address for control memory.
  4. A facility for subroutine call and return.

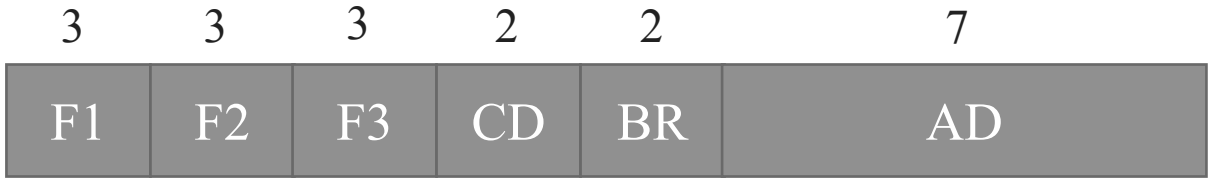
Address Sequencing



Microinstruction Code Format

Section - 3

Microinstruction Code Format



- F1, F2, F3: Microoperation fields
- CD: Condition for branching
- BR: Branch field
- AD: Address field

Symbols & Binary Code for Microinstruction Fields

F1	Microoperation	Symbol
000	None	NOP
001	AC ← AC + DR	ADD
010	AC ← 0	CLRAC
011	AC ← AC + 1	INCAC
100	AC ← DR	DRTAC
101	AR ← DR(0-10)	DRTAR
110	AR ← PC	PCTAR
111	M[AR] ← DR	WRITE

F2	Microoperation	Symbol
000	None	NOP
001	AC ← AC - DR	SUB
010	AC ← AC ∨ DR	OR
011	AC ← AC ∧ DR	AND
100	DR ← M[AR]	READ
101	DR ← AC	ACTDR
110	DR ← DR + 1	INCDR
111	DR(0-10) ← PC	PCTDR

Symbols & Binary Code for Microinstruction Fields

F3	Microoperation	Symbol
000	None	NOP
001	AC ← AC ⊕ DR	XOR
010	AC ← AC'	COM
011	AC ← shl AC	SHL
100	AC ← shr AC	SHR
101	PC ← PC + 1	INCPC
110	PC ← AR	ARTPC
111	Reserved	

CD	Symbol	Comments
00	U - 1	Unconditional branch
01	I - DR(15)	Indirect address bit
10	S - AC(15)	Sign bit of AC
11	Z - AC = 0	Zero value in AC

BR	Symbol	Function
00	JMP	CAR ← AD if condition = 1, CAR ← CAR+1 if condition = 0
01	CALL	CAR ← AD, SBR ← CAR+1 if condition=1, CAR ← CAR+1 if condition=0
10	RET	CAR ← SBR (Return from subroutine)
11	MAP	CAR(2-5) ← DR(11-14), CAR(0,1,6) ← 0

Questions asked in GTU exam

Section - 4

Questions asked in GTU exam

1. Draw and explain flow chart of address sequencing.
2. Draw and explain 20 bits microinstruction code format.
3. What is micro-programmed control architecture?
4. Explain Control Memory.