Faculty of Natural & Applied Sciences
Department of Computer Science
Computer Architecture Test 1

Name: Duration: 1h 30min

1. Perform the following shift operations: (15 points)
   P.S.: Each time, start from the original value of R1

R1	1	0	0	1	1	0	0	1
ASHR								
ASHL								
CIR								
SHL								
~~ASHR~~								
CIL								

2. Design a 4-bit Adder-Decrementor with an external control signal "M"; if (M = 1), the circuit must be a Decrementor, if (M = 0), the circuit must be an Adder. (10 points).

3. Using the common bus, what are the control signals needed to execute the following micro-operations: (12 points).

Micro-Operation	S_2	S_1	S_0	Register Control	Memory	ALU
AC ← AC + DR, IR← IR + 1	~~1~~	~~0~~	~~0~~	LD[AC]; ~~INR[IR]~~		Add → 001
M[AR] ← DR, TR ← DR, DR ← 0	0	1	1	LD[TR]; CLR[DR]	write	

4. Design the following function using a J-K flip flop: (20 points).

wT_0:	F ← 0	Clear F
xT_1:	F ← 1	Set F
$x'T_2$:	F ← F'	Complement F
zT_3:	F ← I'	Load the complement of an external input I to F
$(x + z')T_4$:	F ← G	Load an external input G into F

5. Write the minimum sequence of micro-instructions for the following operations:
   a. M[PC + 2] ← PC + 1 (AC must not change) (5 points).
   b. M[PC – AR] ← M[PC] + M[AR] (AC must not change) (10 points).

6. Design the control signals for the PC register. (13 points).

7. The content of PC in the basic computer is 199 (all numbers are in hexadecimal). The content of AC is 54FD. The content of memory at address 199 is 8320. The content of memory at address 320 is 9020. The content of memory at address 020 is AB02.
   Give the contents of the registers PC, AR, DR, AC, IR, AC, E & I in hexadecimal at the end of the instruction cycle. (15 points).

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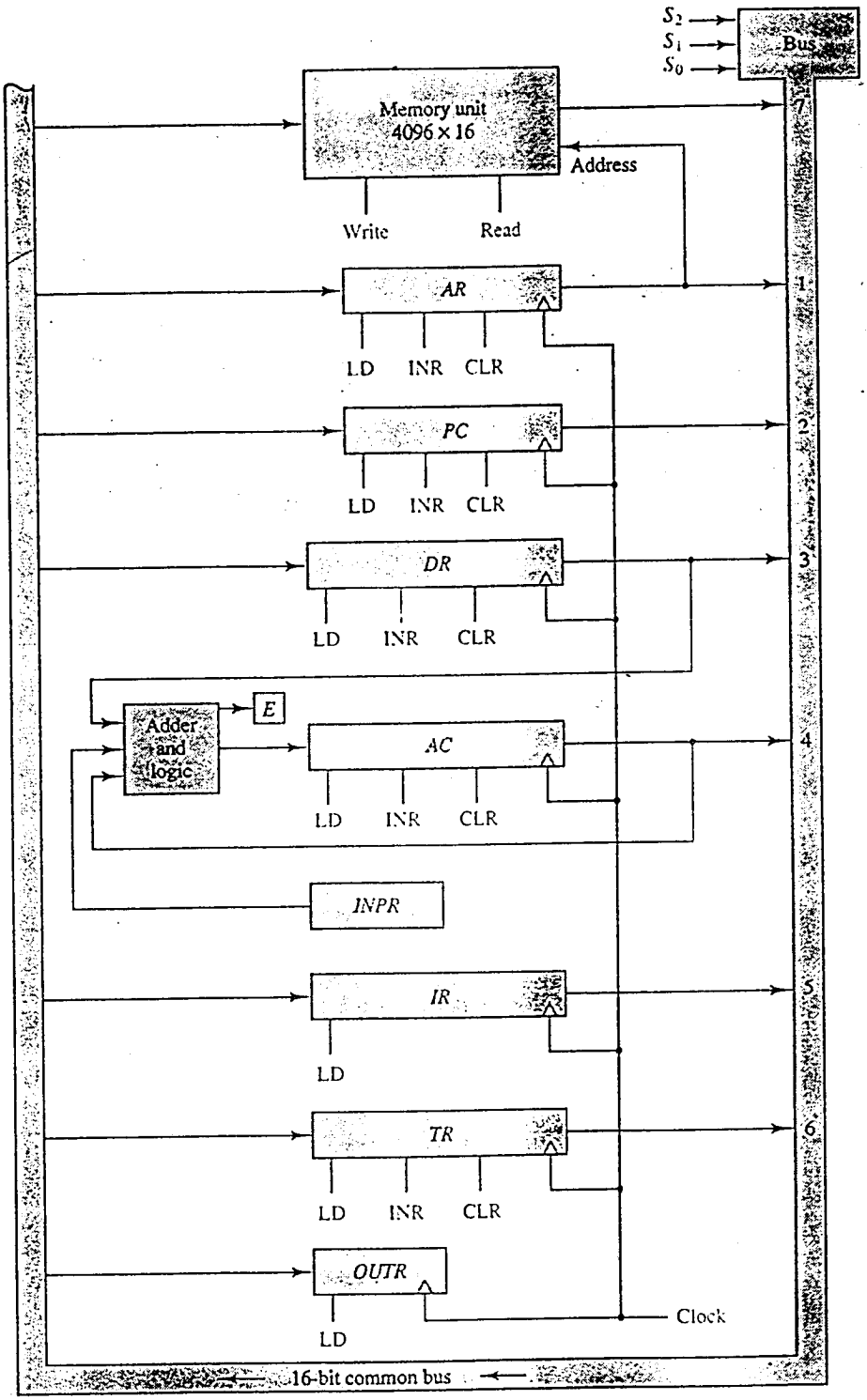

Figure 5-4 Basic computer registers connected to a common bus.