1) {ADD, ADC, ADZ, NDU, NDC, NDZ}

S1 — 0000 — S0

PC → mem.a, alu.a, t3
mem.d → ir
+1 → alu.b
alu.out → PC

S2 — 0001 — S1

ir_{9-11} → rf-a1
ir_{6-8} → rf-a2
ir_{0-7} → PEN
rf-d1 → t1
rf-d2 → t2

S2

if (ir_{15} == 1) { t1 → alu.a, t2 → alu.b, alu.out → t3 } SUB

else if (ir_0 == 0 && ir_1 == 0) || (ir_0 == 0 && ir_1 == 1 && C == 1) || (ir_0 == 1 && ir_1 == 0 && Z == 1))

{ t_1 → alu.a, t2 → alu.b, alu.out → t3 } ADD

else {S1}

S3

★ ALU control in S3:
$ir_{15} + \overline{ir_1}\,Z + \overline{ir_0}\,C + \overline{ir_0}\cdot\overline{ir_1}$

S3 — 0010 — S4

t_3 → rf-d3
if (ir_{14} == 1) { ir_{9-11} → rf-a3 }
else { if (ir_{12} == 0) { ir_{3-5} → rf-a3 }
else { ir_{6-8} → rf-a3 }
t_2 → z

S4 — 0011

Update z flag

(update PC/R7)
if (rf_a3 == 111) { t3 → PC }
else { PC → R7 }

Carry updation not in NDU, NDC, NDZ

$\overline{O}_{15}\ \overline{O}_{14}\ \overline{O}_{13}$

(7) ADI

S1
S2

t1 → alu.a
ir0-5 → SE6 → alu.b
alu.out → t3

S5 (0100) S4

S4 (update PC/R7)

(8) LHI

S1
S2

ir0-8 → 7S → rf-d3
ir9-11 → rf-a3

S6 (0101) S5

(update PC/R7)

(9) LW

S1
S2

t2 → alu.a (S6)
ir0-5 → SE6 → alu.b
alu.out → t2

S7 (0110)

t2 → mem.a
mem.d → t3

S8 (0111) S7

S4 (update PC/R7)

(10) SW

S1
S2
S7 (S6)

t2 → mem.a
t1 → mem.d

S9 (1000)

update (PC/R7)

S8

(11) LM

S1
S2

t1 → mem.a, alu.a
mem.d → t3
t1 → alu.b
alu.out → t1

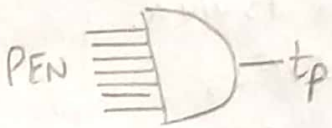
S10 (S9)

if tp == 1

PEN → PEN_i
PEN_o → rf-a3
t3 → rf-d3
if (tp == 1) { go to S10 }
else { S11 }

S10 S11

update PC/R7
update PEN



(12) SM

S1
S2

PEN → PEN_i
PEN_o → rf-a1
rf-d1 → t2

S11 S12

(tp == 1)

update PEN

t1 → mem.a, alu.a
t2 → mem.d
t1 → alu.b
alu_out → t1
if (tp == 1) { go to S12 }
else { S13 }

S12 S13

update PC/R7

(13) BEQ

S1
S2
S3

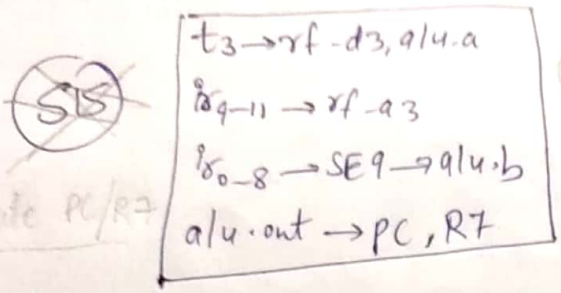
PC → alu.a
ir0-5 → SE6 → alu.b
if (t2 == 1) { aluout → PC, S3 }
else { PC → R7 }

S13 S14

update PC/R7

(14) JAL

S1
S2



(15) JLR

S1
S2