EECS 203 Homework 5 Solutions

2.

(a) (10 pts)

Using the codes provided in the assignment, we can create the following Karnaugh maps, and thereby obtain the equations.

A:

L\RE	00	01	11	10
0	0	1	X	0
1	1	X	X	X

B:

L\RE	00	01	11	10
0	0	1	X	1
1	0	X	X	X

Therefore,

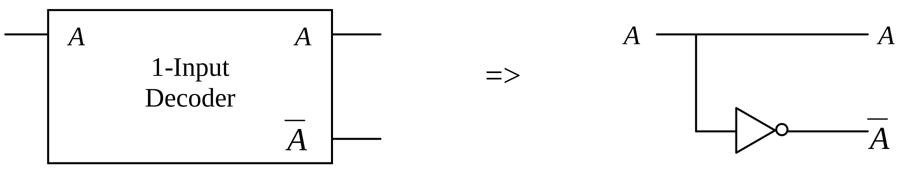
A = L + E

and

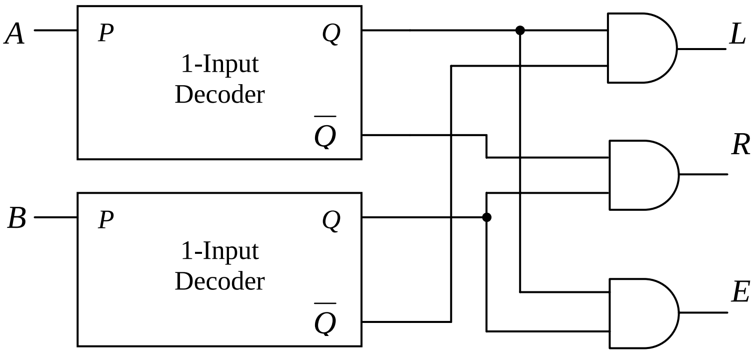
B = R + E

(b) (10 pts)

A *1-input decoder* is shown here:



Therefore, using this and some AND gates, we can decode the signals as follows:



(c) i) (10 pts)

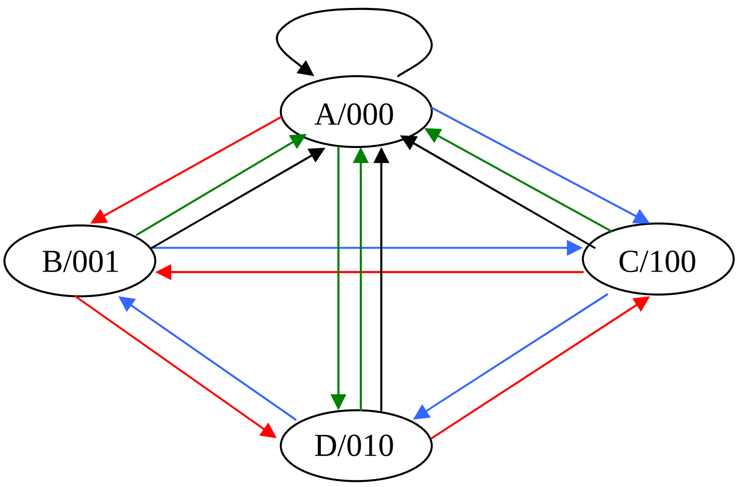
Designs can vary.

N: 00

L: 10

R: 01

E: 11



(c) ii) (5 pts)

	NS				Output
CS	*i* = 00	*i* = 01	*i* = 10	*i* = 11	*pqr*
A	A	C	B	D	000
B	A	C	D	A	001
C	A	D	B	A	100
D	A	B	C	A	010

(c) iii) (5 pts)

CS	NS (*m'n'*)				Output
mn	*i* = 00	*i* = 01	*i* = 10	*i* = 11	*pqr*
A (00)	A (00)	C (10)	B (01)	D (11)	000
B (01)	A (00)	C (10)	D (11)	A (00)	001
C (10)	A (00)	D (11)	B (01)	A (00)	100
D (11)	A (00)	B (01)	C (10)	A (00)	010

(c) iv) (10 pts)

m'		*I* (*ab*)			
CS (*mn*)		00	01	11	10
	00	0	1	1	0
	01	0	1	0	1
	11	0	0	0	1
	10	0	1	0	0

n'		*i* (*ab*)			
CS (*mn*)		00	01	11	10
	00	0	0	1	1
	01	0	0	0	1
	11	0	1	0	0
	10	0	1	0	1

Therefore, we can solve for the equations as follows

$$m' = \bar{m}\bar{n}b + \bar{m}\bar{a}b + na\bar{b} + m\bar{n}\bar{a}b$$

$$n' = \bar{m}\bar{n}a + \bar{m}a\bar{b} + m\bar{a}b + m\bar{n}a\bar{b}$$

$$p = m\bar{n}$$

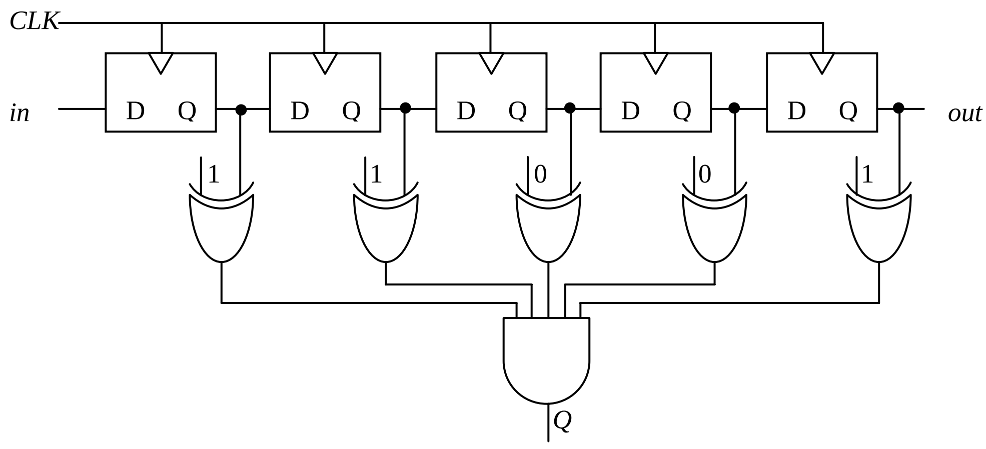
$$q = mn$$

$$r = \bar{m}n$$

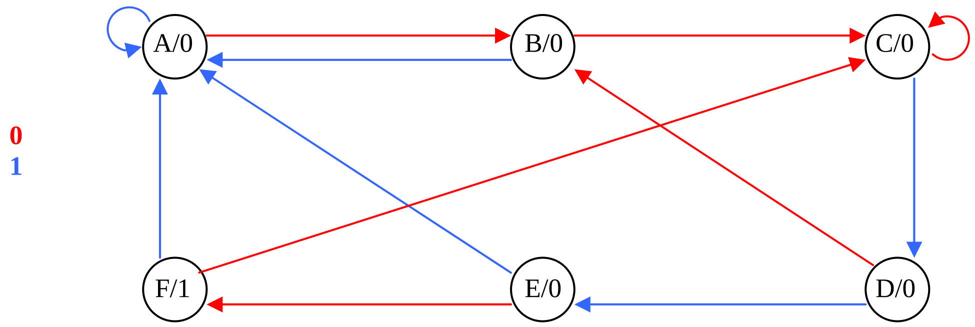
Drawing the circuits should be straightforward using these equations.

4) (10 pts)

Easy solution:



FSM solution:



	Next State		
CS	*i*=0	*i*=1	*f*
A	B	A	0
B	C	A	0
C	C	D	0
D	B	E	0
E	F	A	0
F	C	A	1

CS	Next State ($p'q'r'$)		
pqr	*i*=0	*i*=1	*f*
A (000)	B (110)	A (000)	0
B (110)	C (111)	A (000)	0
C (111)	C (111)	D (001)	0
D (001)	B (110)	E (010)	0
E (010)	F (101)	A (000)	0
F (101)	C (111)	A (000)	1

p'	*ri*			
pq	00	01	11	10
00	1	0	0	1
01	1	0	x	x
11	1	0	0	1
10	x	x	0	1

q'	*ri*			
pq	00	01	11	10
00	1	0	1	1
01	0	0	x	x
11	1	0	0	1
10	x	x	0	1

r'	*ri*			
pq	00	01	11	10
00	0	0	0	0
01	1	0	0	0
11	1	0	1	1
10	x	x	0	1

$$p' = \bar{i}$$

$$q' = \bar{q}\bar{i} + \bar{p}r + p\bar{i} + r\bar{i}$$

$$r' = p\bar{i} + q\bar{r}\bar{i} + pqr$$

$$f = p\bar{q}r$$

Drawing the circuits should be straightforward using these equations.

5)

(a) (5 pts) Mealy

(b) (4 pts)

Current State	Input	Next State	Output
A	0	D	1
	1	C	1
B	0	A	0
	1	F	0
C	0	C	0
	1	E	1
D	0	C	1
	1	C	1
E	0	B	1
	1	E	1
F	0	A	0
	1	D	1

(c) (5 pts)

CS (*pqr*)	Input (*i*)	NS (*p'q'r'*)	Output (*z*)
A (000)	0	D (011)	1
	1	C (010)	1
B (001)	0	A (000)	0
	1	F (101)	0
C (010)	0	C (010)	0
	1	E (100)	1
D (011)	0	C (010)	1
	1	C (010)	1
E (100)	0	B (001)	1
	1	E (100)	1
F (101)	0	A (000)	0
	1	D (011)	1

(d) (10 pts)

p'	*ri*				
		00	01	11	10
pq	00	0	0	1	0
	01	0	1	0	0
	11	x	x	x	x
	10	0	1	0	0

q'	*ri*				
		00	01	11	10
pq	00	1	1	0	0
	01	1	0	1	1
	11	x	x	x	x
	10	0	0	1	0

r'	*ri*				
		00	01	11	10
pq	00	1	0	1	0
	01	0	0	0	0
	11	x	x	x	x
	10	1	0	1	0

z	*ri*				
		00	01	11	10
pq	00	1	1	0	0
	01	0	1	1	1
	11	x	x	x	x
	10	1	1	1	0

$$p' = q\bar{r}i + p\bar{r}i + \bar{p}\bar{q}ri$$

$$q' = \bar{p}\bar{q}\bar{r} + q\bar{r} + qr + pri$$

$$r' = \bar{q}\bar{r}\bar{i} + \bar{q}ri$$

$$z = \bar{q}\bar{r} + pi + qi + qr$$

6)

(a) (5 pts)

It is a Moore machine because the outputs depend on the current state, but not the inputs. Although, one output is different for a different input when the current state is A, the output is a don't care, so we can choose it to be 0 and hence make it a Moore machine.

(b) (5 pts)

CS (*pq*)	Input (*i*)	NS (*p'q'*)	Output (*z*)
A (00)	0	A (00)	0
	1	C (10)	
B (01)	0	D (11)	0
	1	D (11)	
C (10)	0	A (00)	1
	1	B (01)	
D (11)	0	D (11)	0
	1	C (10)	

p'

p\qi	00	01	11	10
0	0	1	1	1
1	0	0	1	1

q'

p\qi	00	01	11	10
0	0	0	1	1
1	0	1	0	1

z

p\qi	00	01	11	10
0	0	0	0	0
1	1	1	0	0

$$p' = q + \overline{p}i$$

$$q' = \overline{p}q + q\overline{i} + p\overline{q}i$$

$$z = p\overline{q}$$