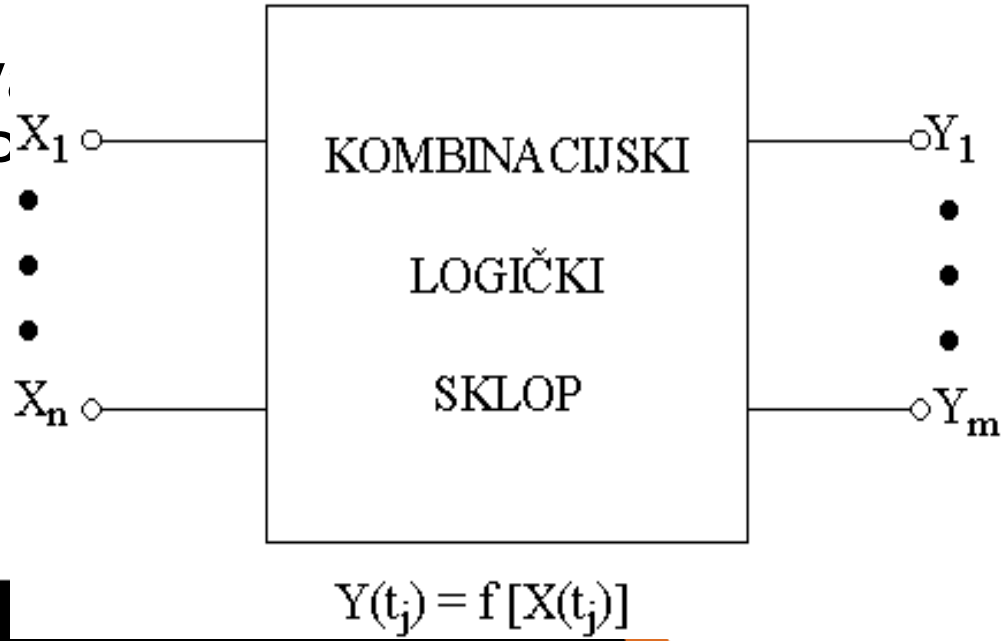
OSNOVE DIGITALNE ELEKTRONIKE

Kombinacijski sklopovi

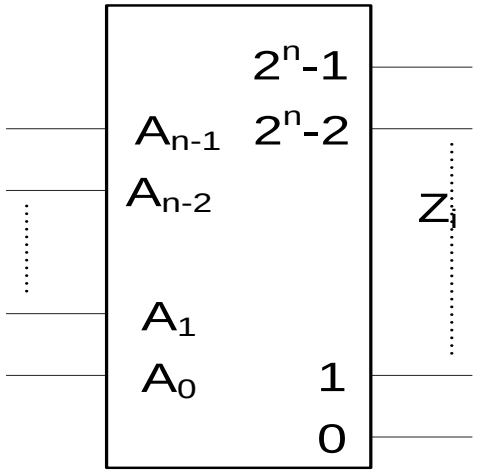
Što su kombinacijski moduli?

- sklopovi kod kojih izlazna logička funkcija ovisi samo o ulaznim veličinama
- Nakon prestanka signala na ulazu, ne zadržavaju signale na izlazu
- primjeri kombinacijskih logičkih sklopov
  multipleksor, dekoder, demultipleksor, P

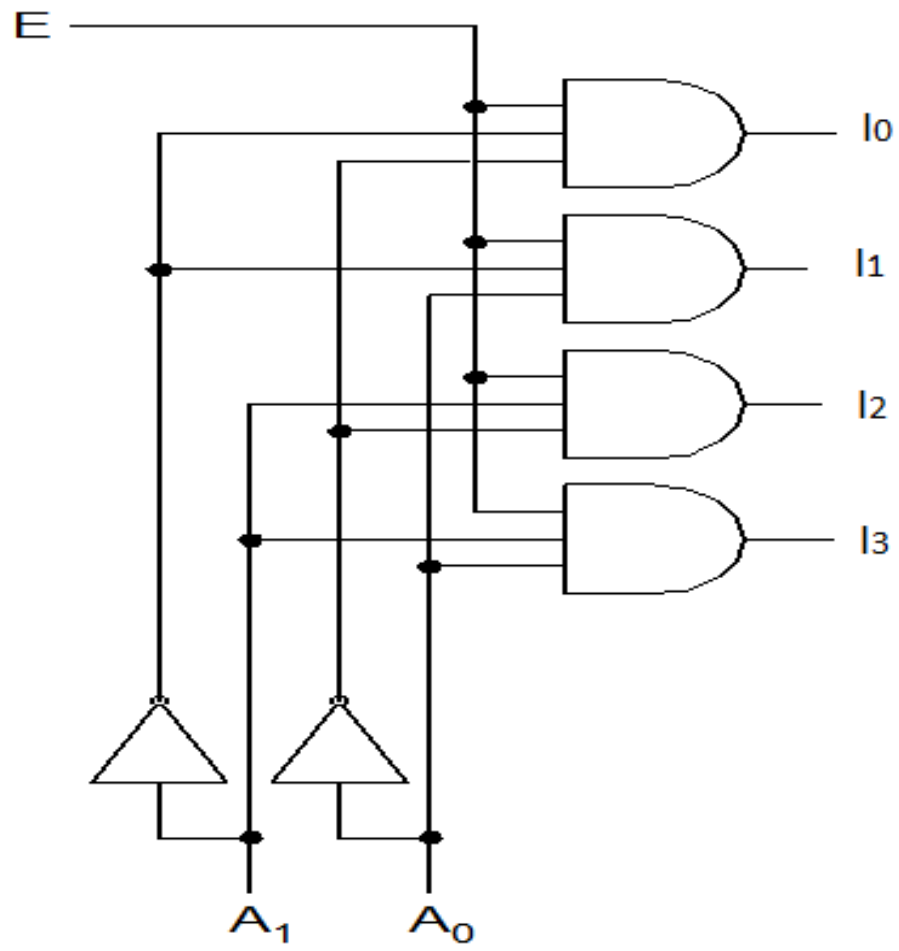


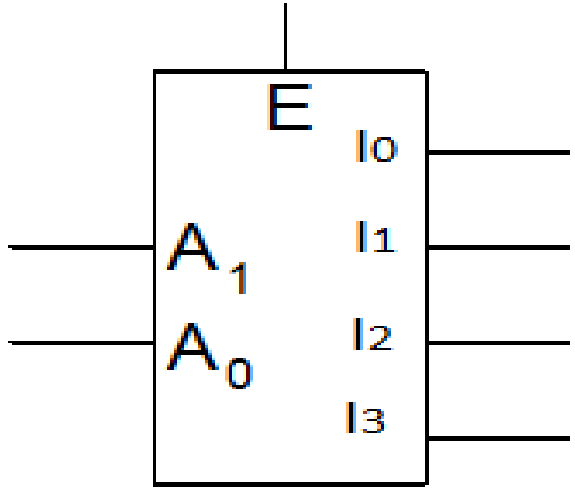
Dekoder/demultipleksor

- Dekoder-aktivira samo jedan izlaz koji odgovara ulaznoj kodnoj riječi
- Demultipleksor-prenosi podatak sa E/D na jedan od odabranih izlaza ovisno o ulaznoj kodnoj riječi-adresi



Dekoder 2/4





Tablica stanja dekodera 2/4

A_1	A_0	E	I_0	I_1	I_2	I_3
x	x	0	0	0	0	0
0	0	1	1	0	0	0
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	0	0	0	1

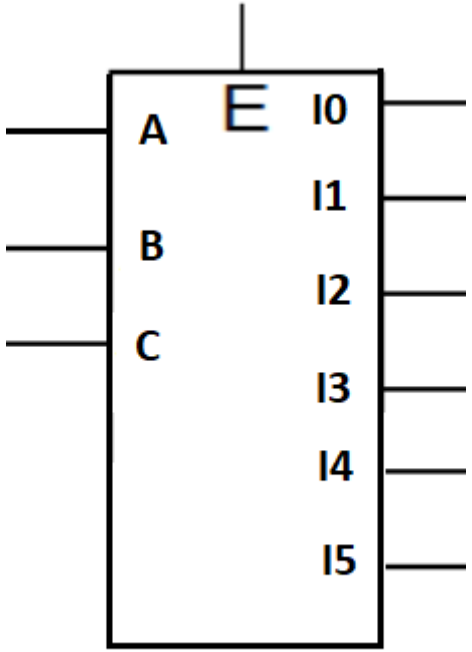
$$I_0 = \overline{A_0}\ \overline{A_1}\ E$$

$$I_1 = A_0\ \overline{A_1}\ E$$

$$I_2 = \overline{A_0}\ A_1\ E$$

$$I_3 = A_0\ A_1\ E$$

Zadatak: Realizirati dekoder sa logičkim sklopovima sa 6 izlaza-(3/6) nacrtati simbol, napisati tablicu stanja i logičke izraze izlaza



A	B	C	E	I0	I1	I2	I3	I4	I5
x	x	x	0	0	0	0	0	0	0
0	0	0	1	1	0	0	0	0	0
0	0	1	1	0	1	0	0	0	0
0	1	0	1	0	0	1	0	0	0
0	1	1	1	0	0	0	1	0	0
1	0	0	1	0	0	0	0	1	0
1	0	1	1	0	0	0	0	0	1

$$I0 = \overline{A}\,\overline{B}\,\overline{C}\,E$$

$$I1 = \overline{A}\,\overline{B}\,C\,E$$

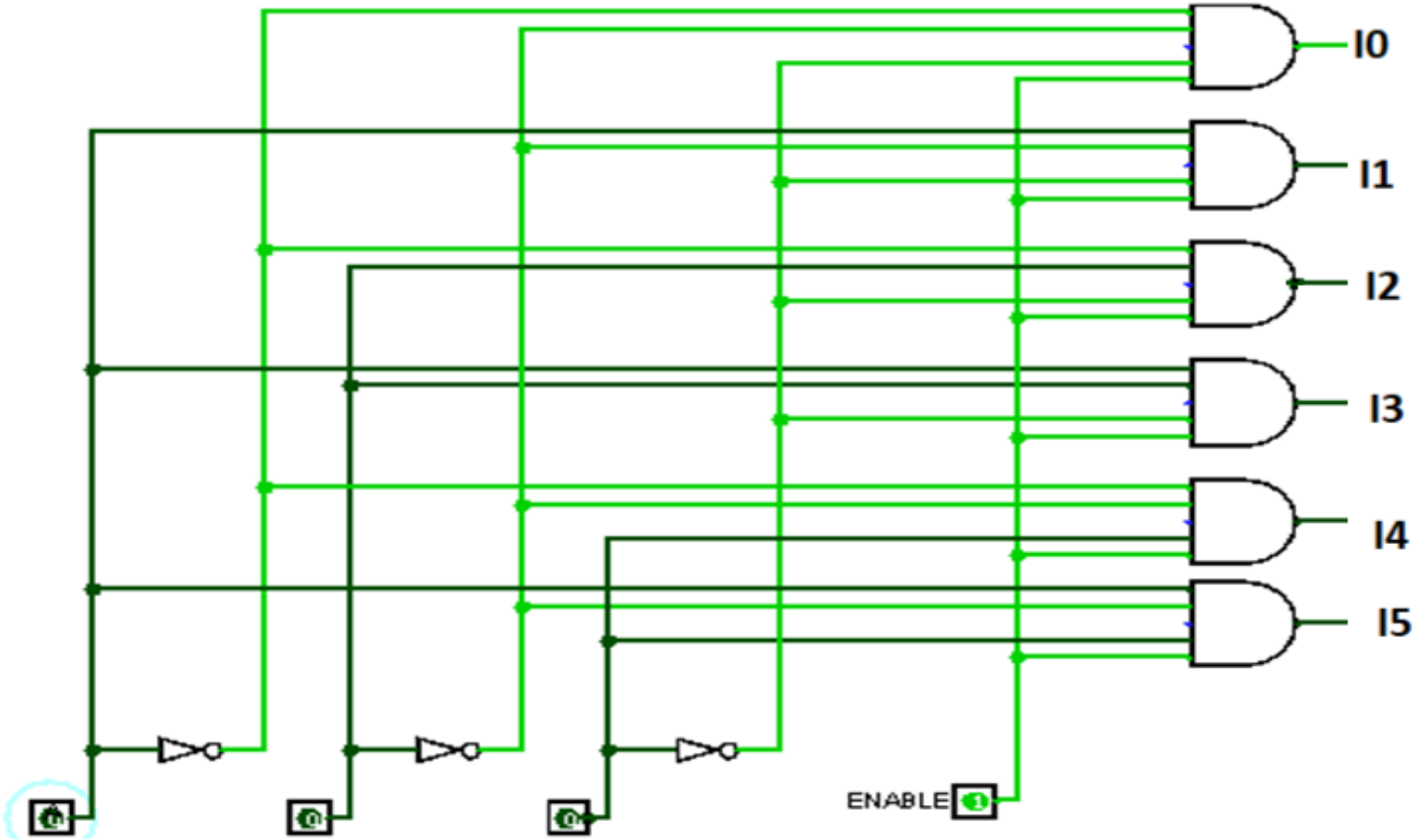
$$I2 = \overline{A}\,B\,\overline{C}\,E$$

$$I3 = \overline{A}\,B\,C\,E$$

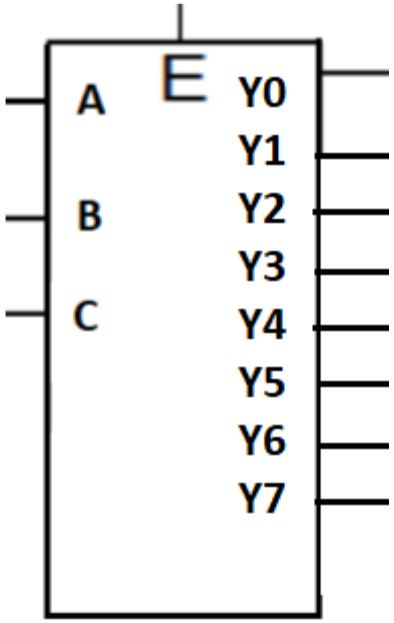
$$I4 = A\,\overline{B}\,\overline{C}\,E$$

$$I5 = A\,\overline{B}\,C\,E$$

Logička shema dekodera 3/6



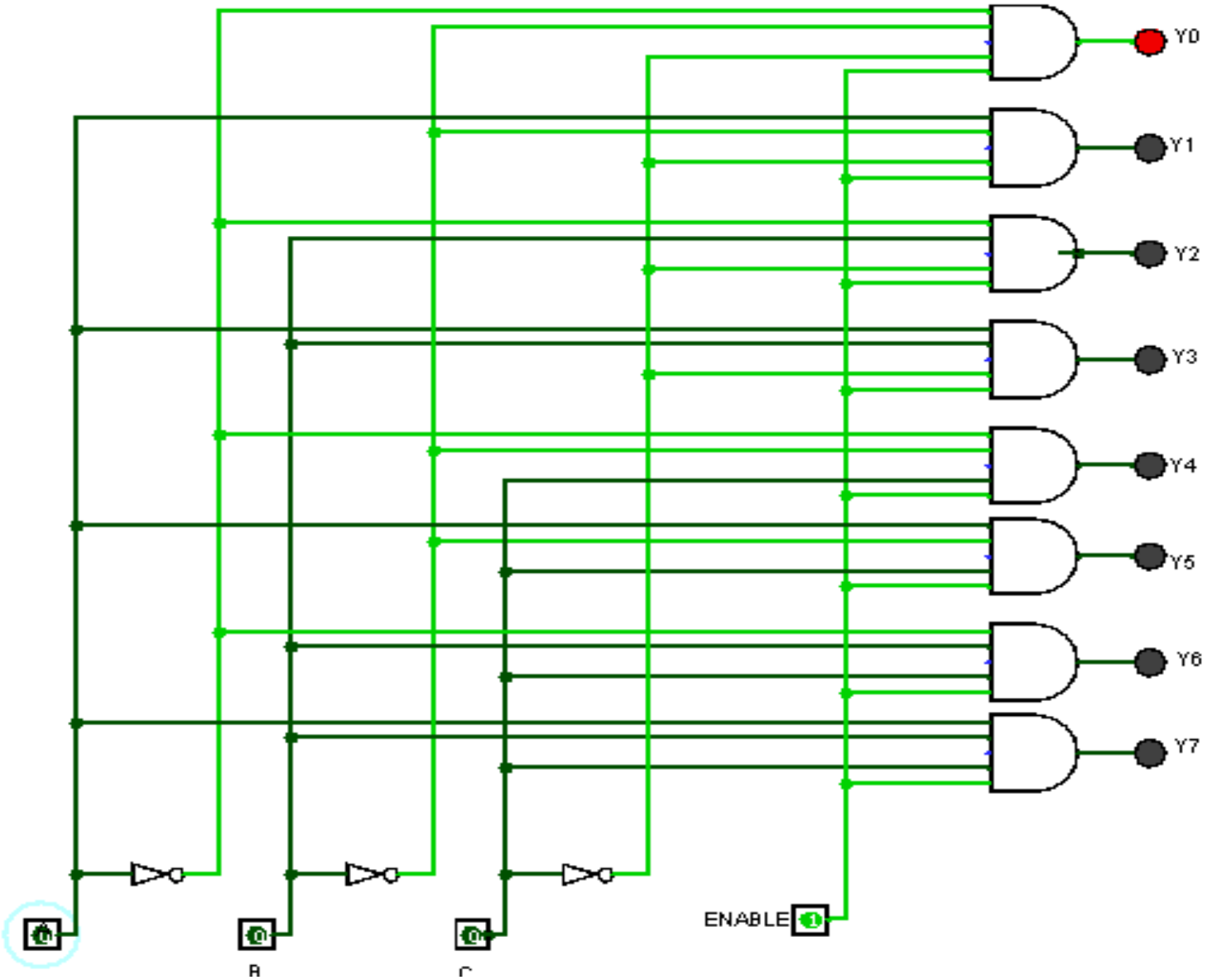
Zadatak:Realizirati dekoder sa logičkim sklopovima sa 8 izlaza-(3/8) nacrtati simbol, napisati tablicu stanja i logičke izraze izlaza



A	B	C	E	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
x	x	x	0	0	0	0	0	0	0	0	0
0	0	0	1	1	0	0	0	0	0	0	0
0	0	1	1	0	1	0	0	0	0	0	0
0	1	0	1	0	0	1	0	0	0	0	0
0	1	1	1	0	0	0	1	0	0	0	0
1	0	0	1	0	0	0	0	1	0	0	0
1	0	1	1	0	0	0	0	0	1	0	0
1	1	0	1	0	0	0	0	0	0	1	0
1	1	1	1	0	0	0	0	0	0	0	1

$$Y0 = \overline{A}\,\overline{B}\,\overline{C}\,E$$
$$Y1 = \overline{A}\,\overline{B}\,C\,E$$
$$Y2 = \overline{A}\,B\,\overline{C}\,E$$
$$Y3 = \overline{A}\,B\,C\,E$$
$$Y4 = A\,\overline{B}\,\overline{C}\,E$$
$$Y5 = A\,\overline{B}\,C\,E$$
$$Y6 = A\,B\,\overline{C}\,E$$
$$Y7 = A\,B\,C\,E$$

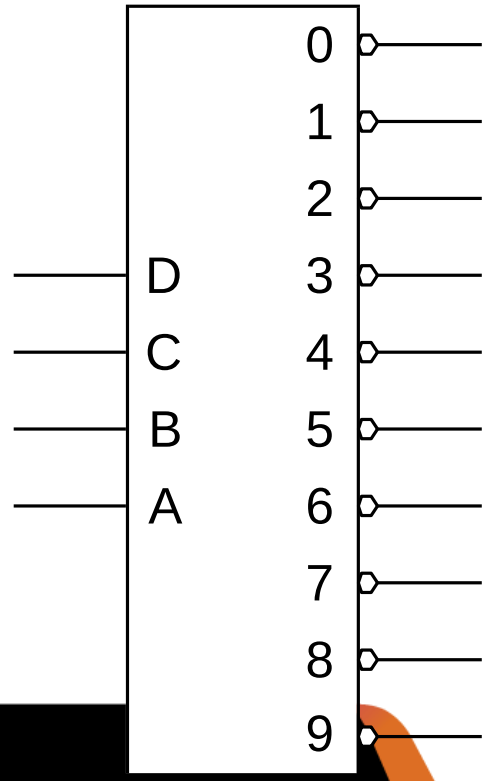
Dekoder 3/8



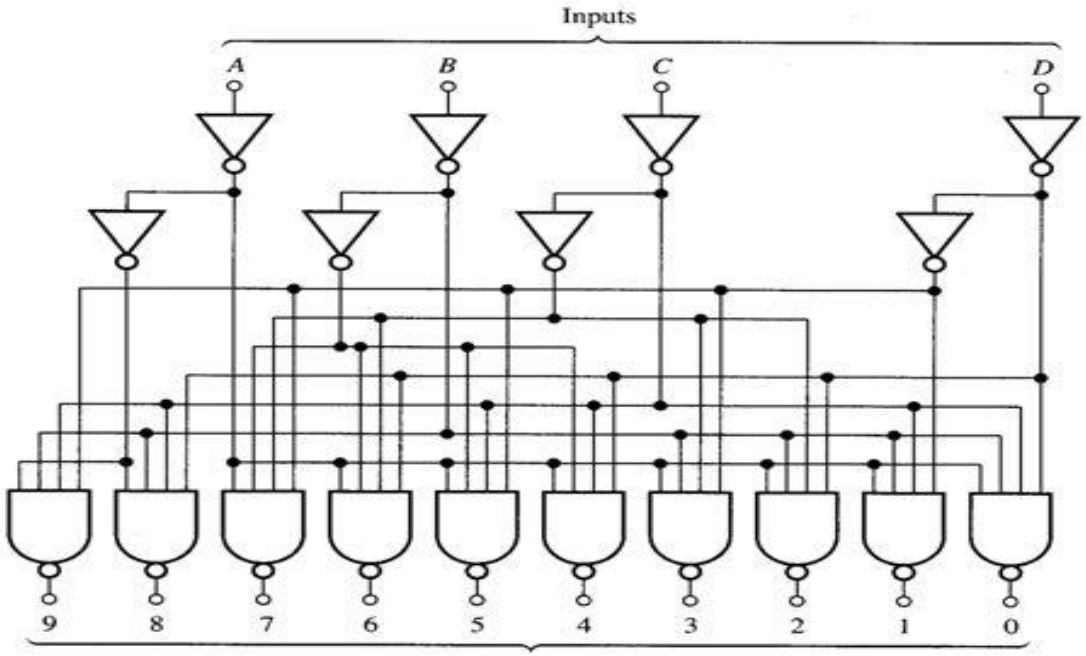
BCD dekoder

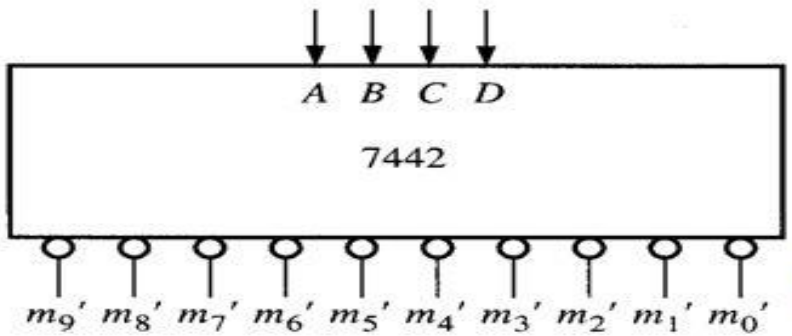
- *dekadski* dekoderi:
  - n = 4 ulaza → "1-od-10" izlaza
  - posebna funkcija: dekodiranje *nekih* binarnih kodova za prikaz dekadskih znamenki npr. BCD, XS-3
- *binarni* dekoderi:
  - n = 2, 3, 4, ... ulaza → "1-od-2^n" izlaza

- oznake: D ~ najnižu težinu (2^0)
- 74LS42 je *dekoder* 4-u-10,



Decoders





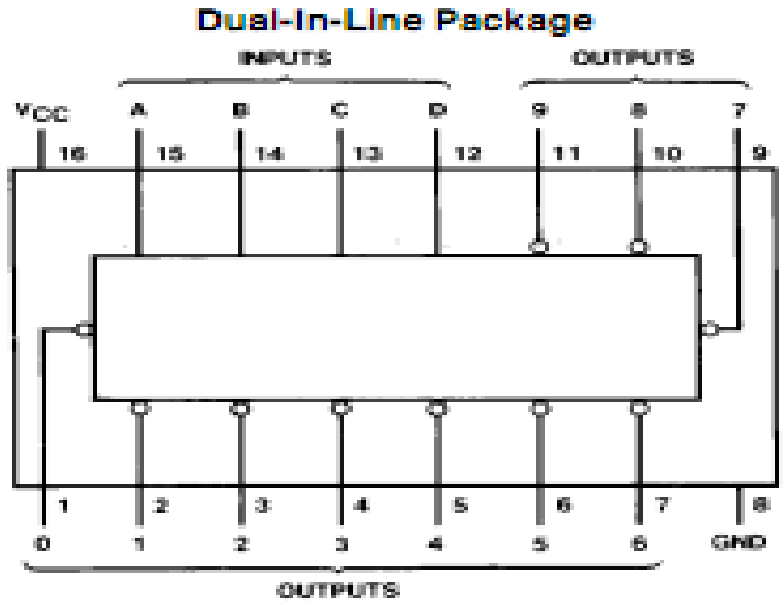
7442 4-to-10 decoder

BCD Input				Decimal Output									
A	*B*	*C*	*D*	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	1	1	1	1	1	1	1	1	1
0	0	0	1	1	0	1	1	1	1	1	1	1	1
0	0	1	0	1	1	0	1	1	1	1	1	1	1
0	0	1	1	1	1	1	0	1	1	1	1	1	1
0	1	0	0	1	1	1	1	0	1	1	1	1	1
0	1	0	1	1	1	1	1	1	0	1	1	1	1
0	1	1	0	1	1	1	1	1	1	0	1	1	1
0	1	1	1	1	1	1	1	1	1	1	0	1	1
1	0	0	0	1	1	1	1	1	1	1	1	0	1
1	0	0	1	1	1	1	1	1	1	1	1	1	0
1	0	1	0	1	1	1	1	1	1	1	1	1	1
1	0	1	1	1	1	1	1	1	1	1	1	1	1
1	1	0	0	1	1	1	1	1	1	1	1	1	1
1	1	0	1	1	1	1	1	1	1	1	1	1	1
1	1	1	0	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1

Note: Active low outputs

7442

Connection Diagram

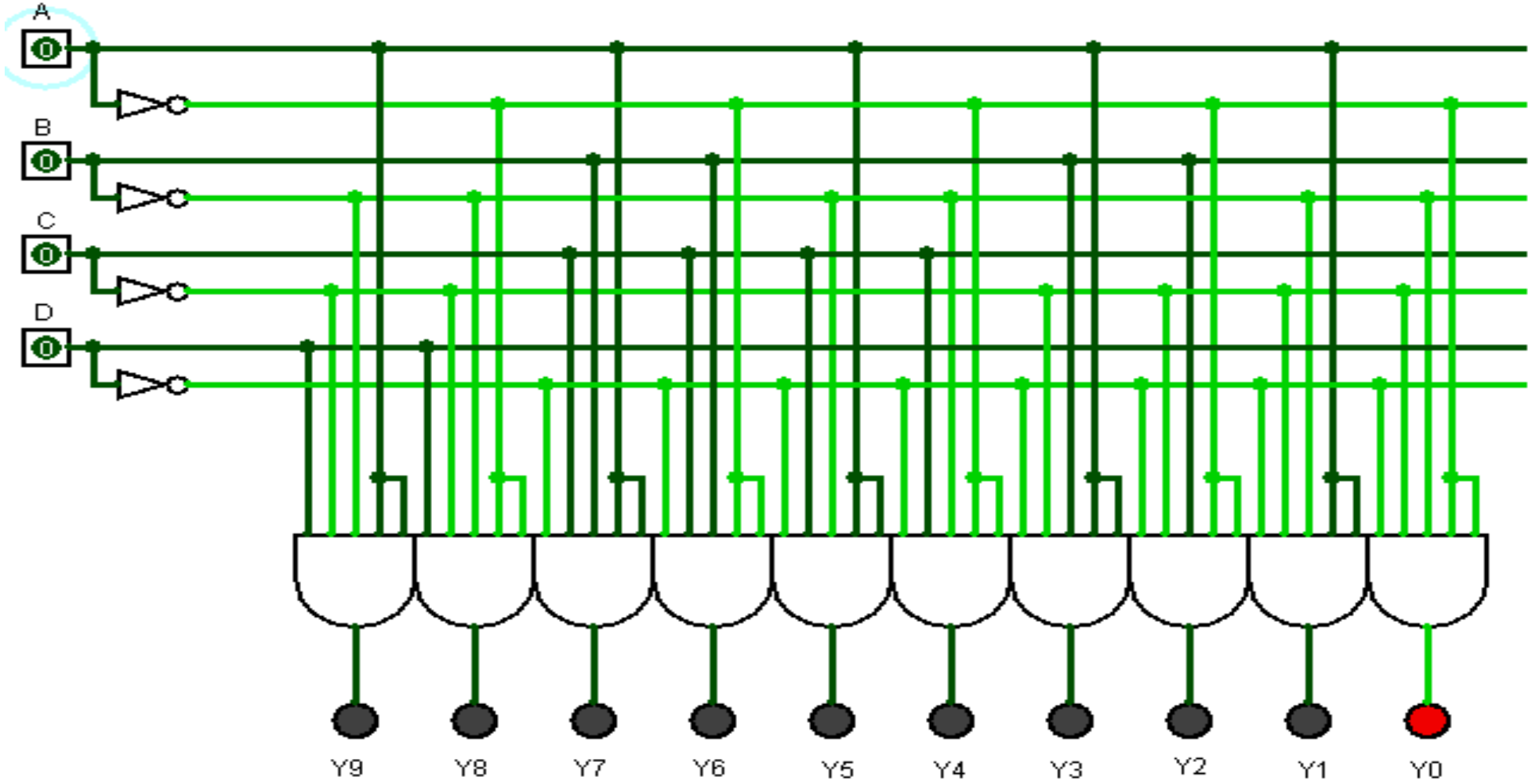


Function Table

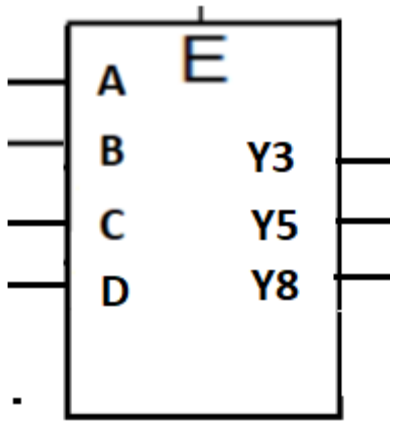
No.	BCD Inputs				Decimal Outputs									
	D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	L	L	L	L	L	H	H	H	H	H	H	H	H	H
1	L	L	L	H	H	L	H	H	H	H	H	H	H	H
2	L	L	H	L	H	H	L	H	H	H	H	H	H	H
3	L	L	H	H	H	H	H	L	H	H	H	H	H	H
4	L	H	L	L	H	H	H	H	L	H	H	H	H	H
5	L	H	L	H	H	H	H	H	H	L	H	H	H	H
6	L	H	H	L	H	H	H	H	H	H	L	H	H	H
7	L	H	H	H	H	H	H	H	H	H	H	L	H	H
8	H	L	L	L	H	H	H	H	H	H	H	H	L	H
9	H	L	L	H	H	H	H	H	H	H	H	H	H	L
INVALID	H	L	H	L	H	H	H	H	H	H	H	H	H	H
	H	L	H	H	H	H	H	H	H	H	H	H	H	H
	H	H	L	L	H	H	H	H	H	H	H	H	H	H
	H	H	L	H	H	H	H	H	H	H	H	H	H	H
	H	H	H	L	H	H	H	H	H	H	H	H	H	H
	H	H	H	H	H	H	H	H	H	H	H	H	H	H

H = High Level
L = Low Level

BCD-dekoder



Zadatak: Realizirati dekoder koji dekodira znamenke 3, 5 ,8 u BCD kodu-nacrtati simbol, logičku shemu, napisati tablicu stanja i logičke izraze.(bez nacrtanog ulaza E u logičkoj shemi)

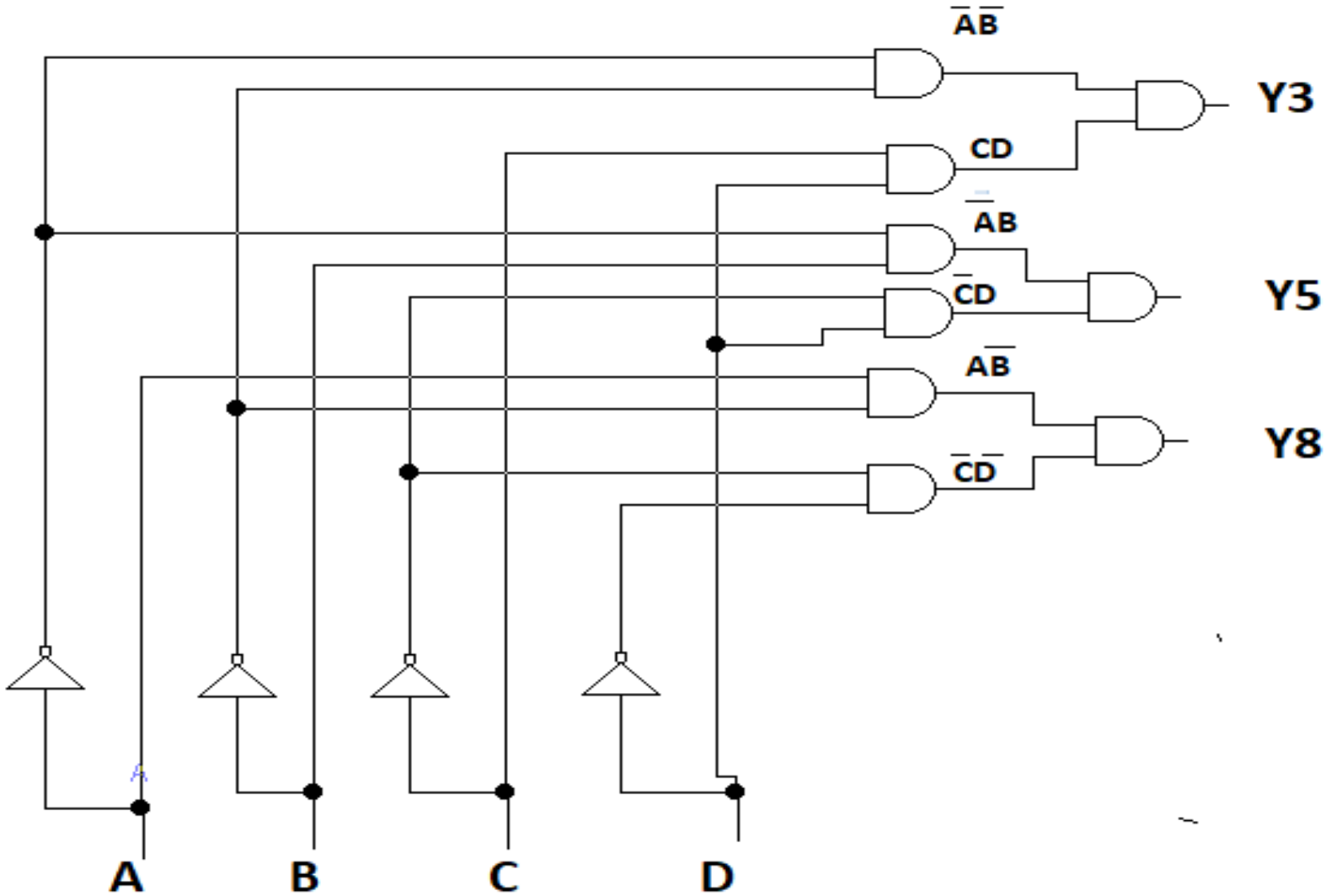


$$Y3 = \overline{A}\,\overline{B}\,C\,D\,E$$

$$Y5 = \overline{A}\,B\,\overline{C}\,D\,E$$

$$Y8 = A\,\overline{B}\,\overline{C}\,\overline{D}\,E$$

E	A B C D	Y3	Y5	Y8
1	0 0 1 1	1	0	0
1	0 1 0 1	0	1	0
1	1 0 0 0	0	0	1

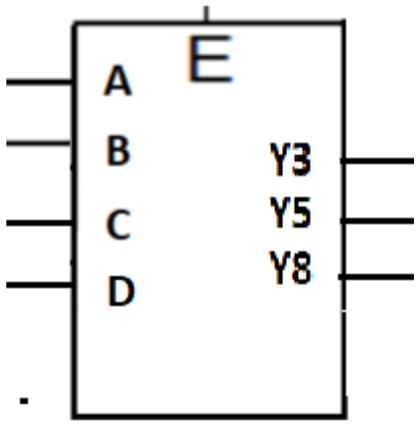


$Y3 = \bar{A}\,\bar{B}\,C\,D\,E$

$Y5 = \bar{A}\,B\,\bar{C}\,D\,E$

$Y8 = A\,\bar{B}\,\bar{C}\,\bar{D}\,E$

Zadatak: Realizirati dekoder koji dekodira znamenke 3, 5 ,8 u XS-3 kodu-nacrtati simbol, logičku shemu, napisati tablicu stanja i logičke izraze.



$$Y3 = \overline{A}\,B\,C\,\overline{D}\,E$$

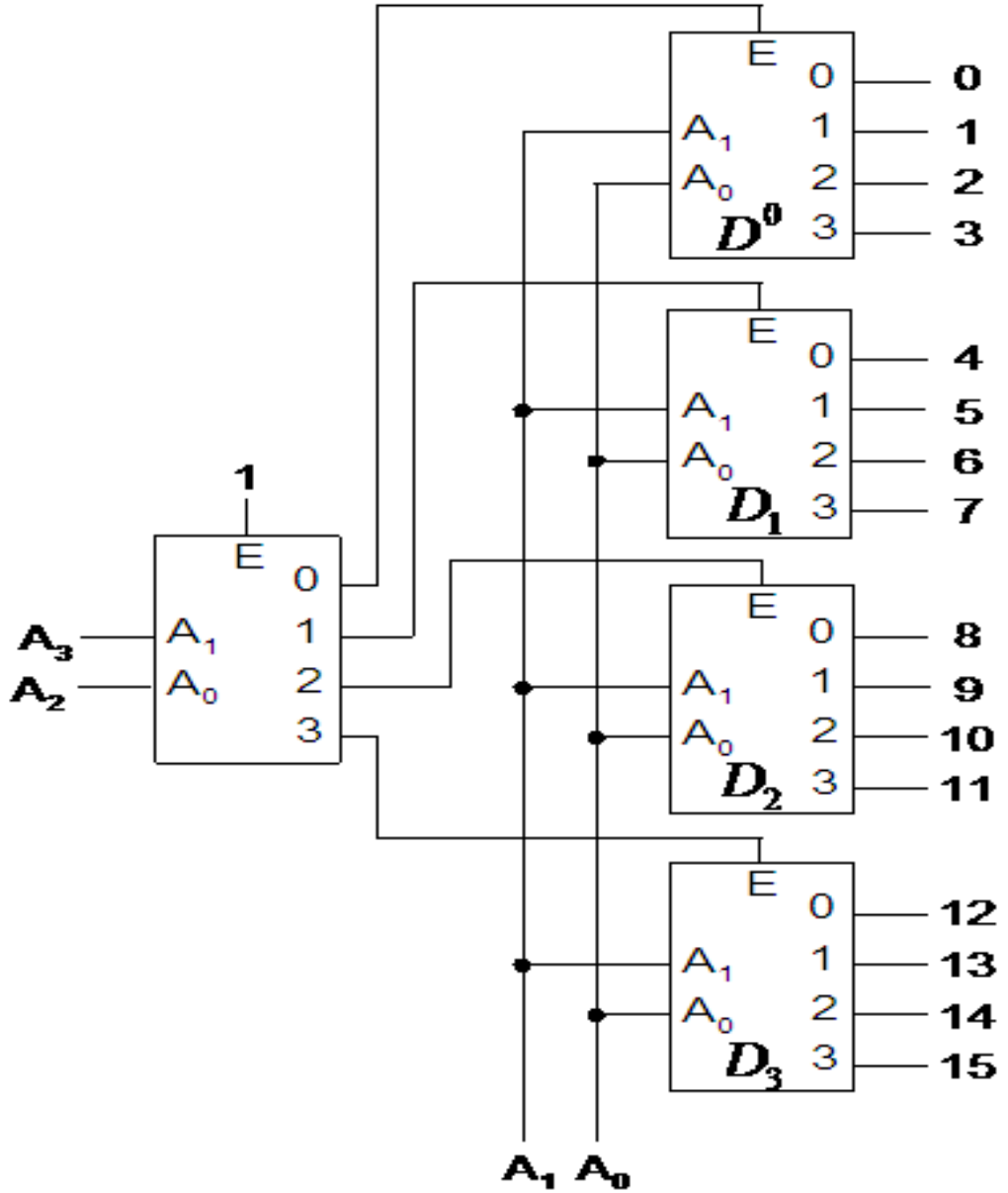
$$Y5 = A\,\overline{B}\,\overline{C}\,\overline{D}\,E$$

$$Y8 = A\,\overline{B}\,C\,D\,E$$

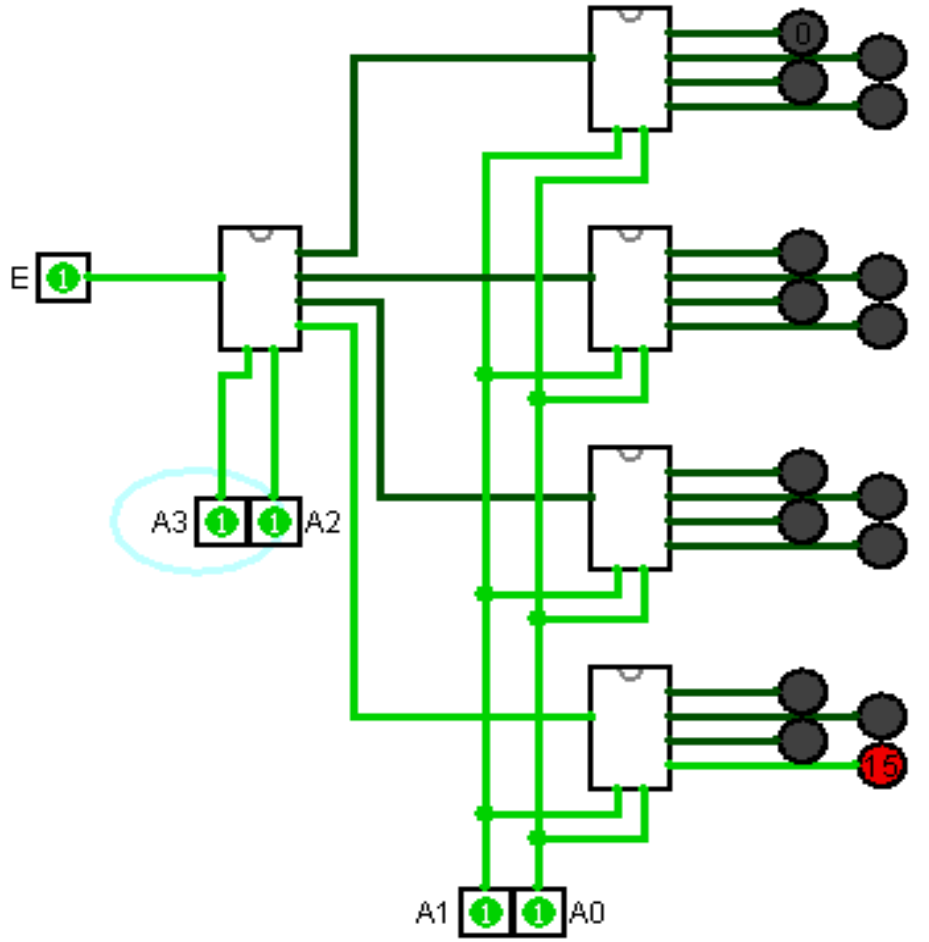
E	A B C D	Y3	Y5	Y8
1	0 1 1 0	1	0	0
1	1 0 0 0	0	1	0
1	1 0 1 1	0	0	1

Dekodersko stabla – povećanje broja izlaza

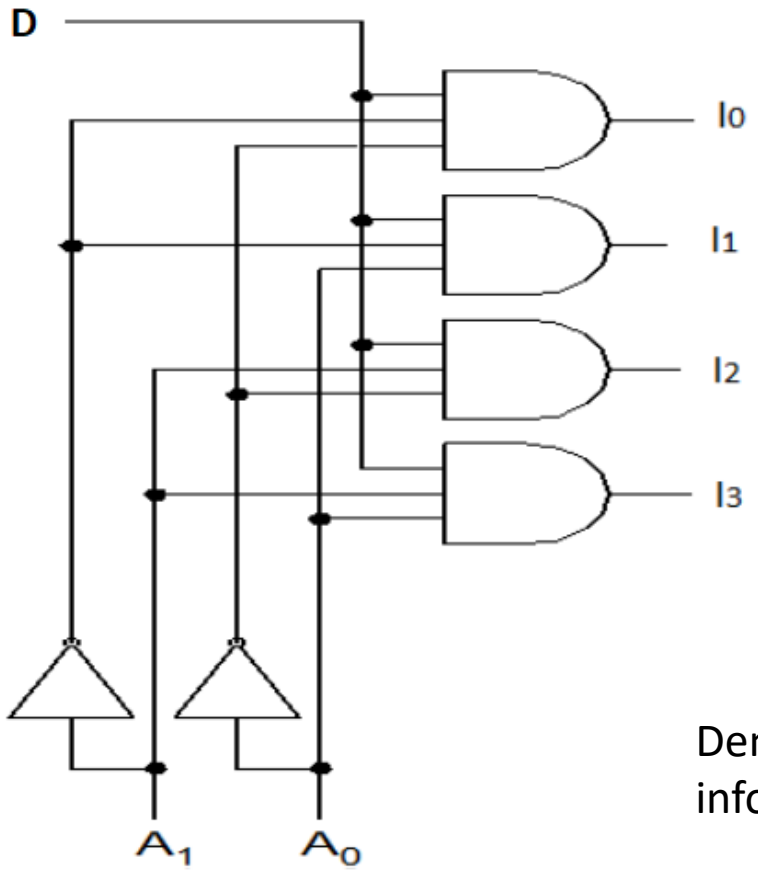
A_3	A_2	A_1	A_0	
0	0	0	0	D_0^1
		0	1	
		1	0	
		1	1	
0	1	0	0	D_1^1
		0	1	
		1	0	
		1	1	
1	0	0	0	D_2^1
		0	1	
		1	0	
		1	1	
1	1	0	0	D_3^1
		0	1	
		1	0	
		1	1	

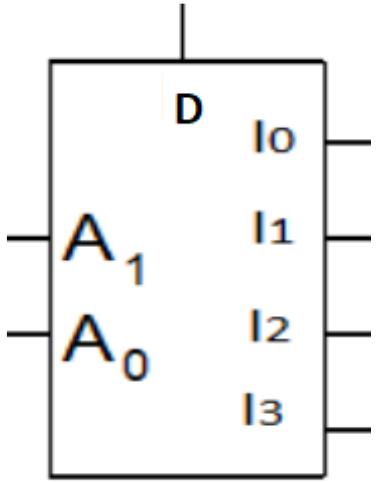


Simulacija dekoderskog stabla



Demultipleksor-sklop koji sa ulaza D prenosi podatke na jedan od adresiranih (odabranih) izlaza





Demultipleksor ima ulaz **D** (umjesto E) za dovođenje informacije=serijsko-paralelni prijenos

Tablica stanja i logički izrazi demultipleksora sa 4 izlaza

A_1	A_0	I_0	I_1	I_2	I_3
x	x	0	0	0	0
0	0	D	0	0	0
0	1	0	D	0	0
1	0	0	0	D	0
1	1	0	0	0	D

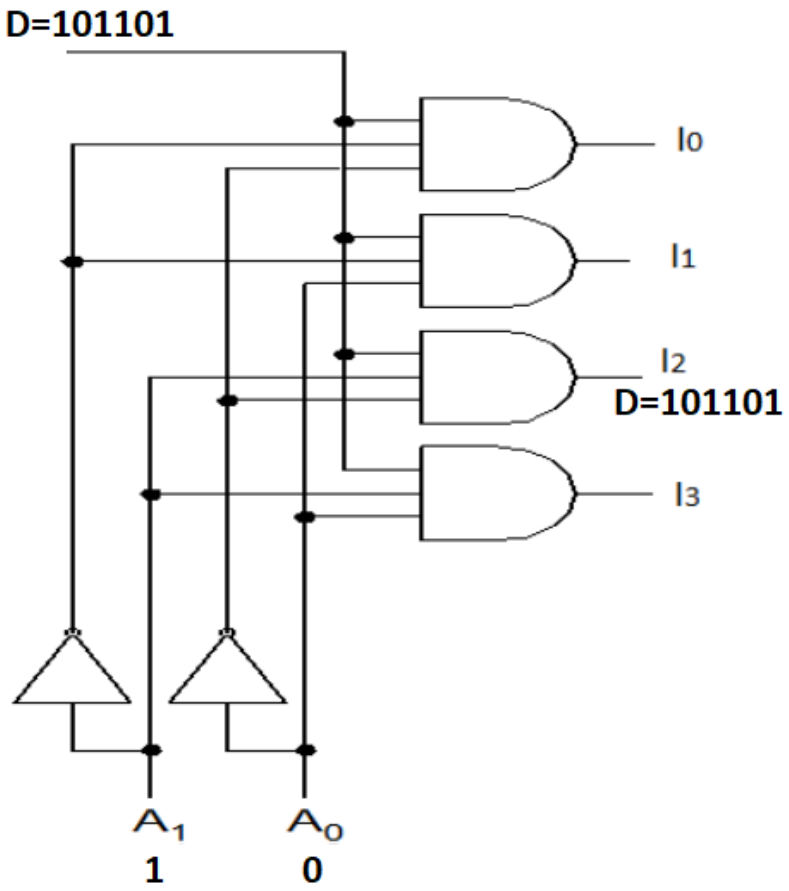
$$I_0 = \overline{A_0}\ \overline{A_1}\ D$$

$$I_1 = A_0\ \overline{A_1}\ D$$

$$I_2 = \overline{A_0}\ A_1\ D$$

$$I_3 = A_0\ A_1\ D$$

Zadatak: Realizirati sklop sa logičkim sklopovima koji će podatak D=101101 prenijeti na jedan od 4 izlaza. Odrediti na koji izlaz će se prenijeti podatak , ako je stanje adresnih linija 10.



A_1	A_0	I_0	I_1	I_2	I_3
x	x	0	0	0	0
0	0	D	0	0	0
0	1	0	D	0	0
1	0	0	0	D	0
1	1	0	0	0	D

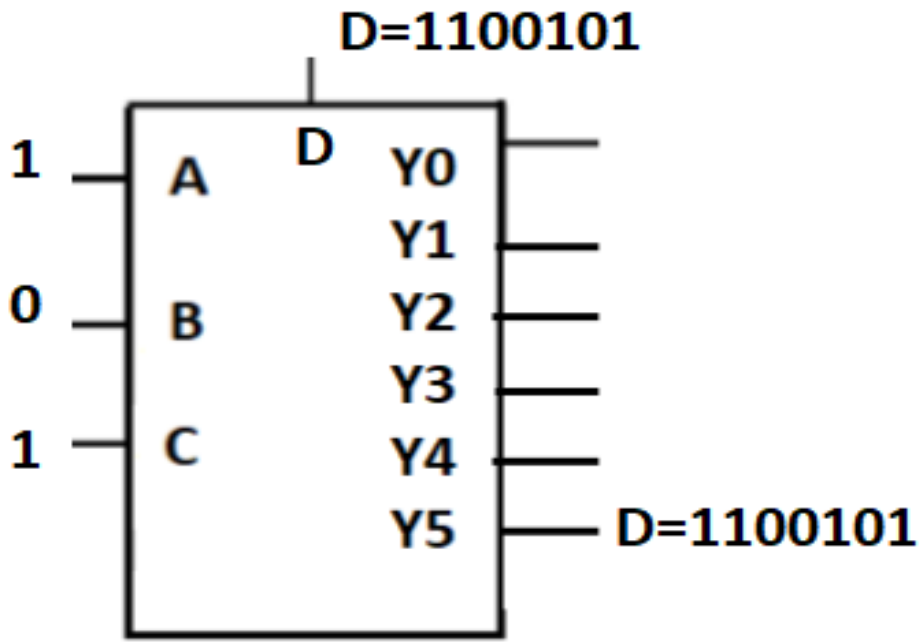
$I_0 = \overline{A_0}\ \overline{A_1}\ D$

$I_1 = A_0\ \overline{A_1}\ D$

$I_2 = \overline{A_0}\ A_1\ D$

$I_3 = A_0\ A_1\ D$

Zadatak: Koje stanje na adresnim linijama treba postaviti da bi se podatak sa ulaza D=1100101 prenio na Y5 od ukupno 6 izlaza demultipleksora?



A	B	C	Y0	Y1	Y2	Y3	Y4	Y5
x	x	x	0	0	0	0	0	0
0	0	0	D	0	0	0	0	0
0	0	1	0	D	0	0	0	0
0	1	0	0	0	D	0	0	0
0	1	1	0	0	0	D	0	0
1	0	0	0	0	0	0	D	0
1	0	1	0	0	0	0	0	D