VIVEKANANDA COLLEGE
THAKURPUKUR
KOLKATA-700063

NAAC ACCREDITED 'A' GRADE

Topic: Flip-flop conversion

Course Title: Digital Electronics and VHDL

Paper: ELT-A-CC-4-09-TH

Unit: Sequential Circuit

Semester: Fourth

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Name of the Department: Electronic Science

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Realisation of one flip-flop using other flip-flop

(1) To realise a flip-flop (X) using another flip-flop (Y) →

steps

(i) obtain present state - next state (PS-NS) table for flip-flop (X)

ii) use the excitation or application table of flip flop (Y), add the values to the present-state-next state table.

iii) using K-maps, simplify the logic expressions for excitation inputs of flip-flop (Y) and design next-state decoder logic.

* next-state decoder — flip flop (Y) along with a combinational circuit is called NEXT state decoder.

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(1) Realisation of D-flip-flop using S-R Flip-flop

i) D is the (X) flip-flop

ii) S-R is (Y) - flip flop

iii) PS-NS table of D-flip flop

Q_n	D	Q_{n+1}
0	0	0
0	1	1
1	0	0
1	1	1

iv) application table of SR flip-flop

Q_n	Q_{n+1}	Excitation inputs S	R
0	0	0	d
0	1	1	0
1	0	0	1
1	1	d	0

v) Excitation table for D flip-flop using S-R

Q_n	D	Q_{n+1}	Excitation inputs S	R
0	0	0	0	d
0	1	1	1	0
1	0	0	0	1
1	1	1	d	0

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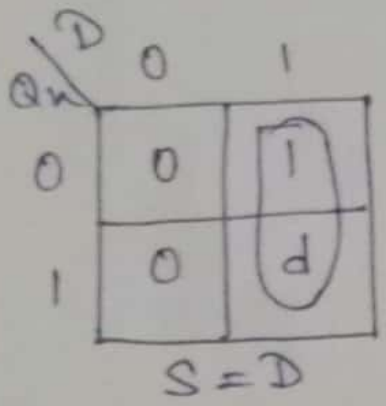
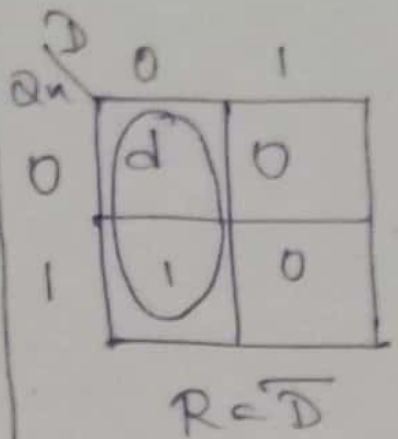
iv) For K-MAP from excitation maps.

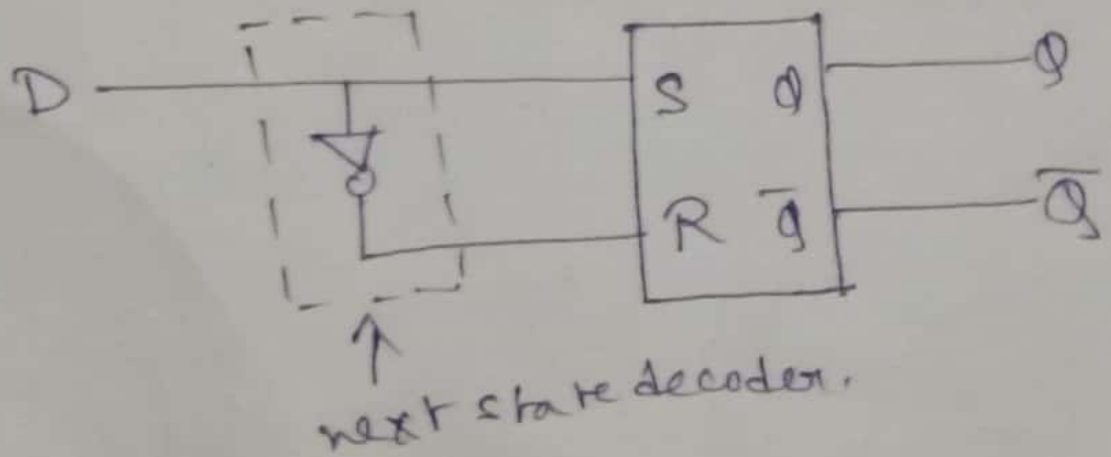
Excitation map for S



Excitation map for R



v) From above K-MAP. construct D flip-flop using S-R flip-flop



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Realisation of J-K flip-flop using S-R flip-flop.

i) PS-NS table for J-K flip-flop.

Q_n	J	K	Q_{n+1}
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

ii) using application table of S-R flip-flop realise Excitation table for J-K flip-flop.

Q_n	J	K	Q_{n+1}	Excitation inputs	
				S	R
0	0	0	0	0	d
0	0	1	0	0	d
0	1	0	1	1	0
0	1	1	1	1	0
1	0	0	1	d	0
1	0	1	0	0	1
1	1	0	1	d	0
1	1	1	0	0	1

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iv) Excitation map for S

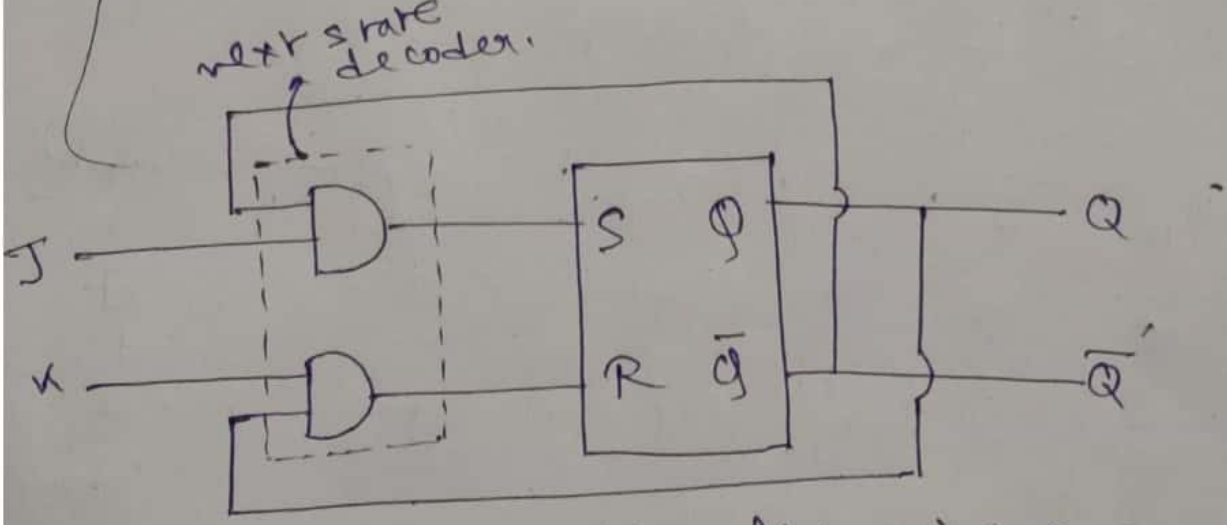
Q_n \ JK	00	01	11	10
0	0	0	1	1
1	d	0	0	d

$S = J\overline{Q_n}$

v) Excitation table for R

Q_n \ JK	00	01	11	10
0	d	d	0	0
1	0	1	1	0

$R = KQ_n$



J-K flip flop using S-R.

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Realisation of T Flip-flop using D Flip flop :-

i) PS-NS table of T Flip-flop.

Q_n	T	Q_{n+1}
0	0	0
1	0	1
0	1	1
1	1	0

ii) Next the table shows characteristic table of T flip flop along with the excitation input of D Flip-flop

T	Q_t	Q_{t+1}	D
0	0	0	0
0	1	1	1
1	0	1	1
1	1	0	0

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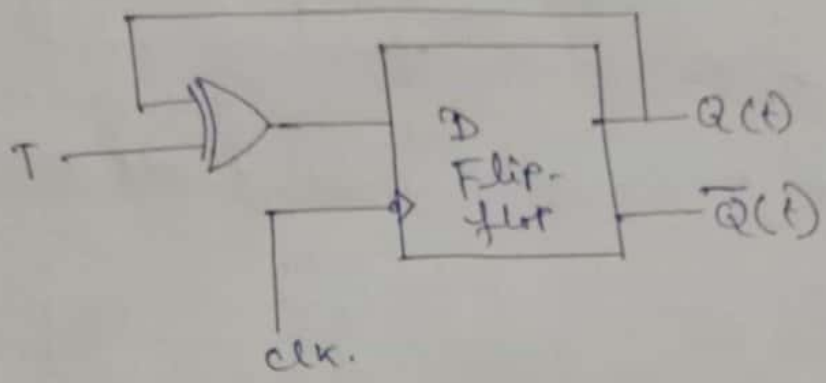
iii) K-map for D

Q_n \ T	0	1
0	0	1
1	1	0

$D = T \oplus Q_n$



T flip flop using D flip-flop

Realisation of D Flip-flop using JK Flip-flop :-

i) PS-NS table of D flip-flop

Q_n	D	Q_{n+1}
0	0	0
0	1	1
1	0	0
1	1	1

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ii) Excitation table for D flip-flop realisation using J-K Flip-flop

Q_n	D	Q_{n+1}	Excitation inputs	
			J	K
0	0	0	0	d
0	1	1	1	d
1	0	0	d	1
1	1	1	d	0

iii) K-map for J

Q_n \ D	0	1
0	0	1
1	d	d

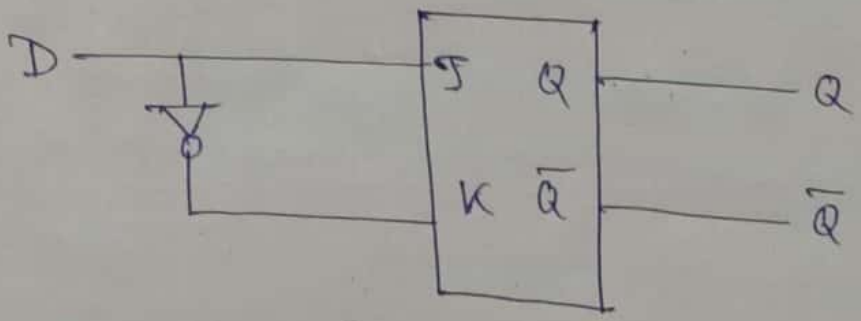
$J = D$

K-map for K

Q_n \ D	0	1
0	d	d
1	1	0

$K = \bar{D}$

iv)



D flip flop using K-flip-flop

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Realisation of T-flip-flop using J-K Flip-flop :-

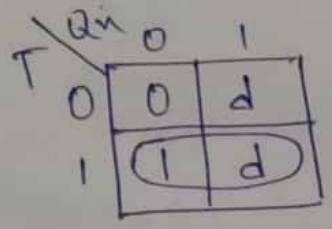
i) PS-NS table of T Flip-flop

T	Q_n	Q_{n+1}
0	0	0
0	1	1
1	0	1
1	1	0

ii) Excitation table for T flip-flop realisation using J-K Flip flop.

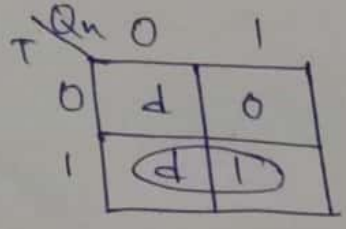
T	Q_n	Q_{n+1}	Excitation inputs	
			J	K
0	0	0	0	d
0	1	1	d	0
1	0	1	1	d
1	1	0	d	1

iii) K-map for J



$J = T$

K-Map for K



$K = T$

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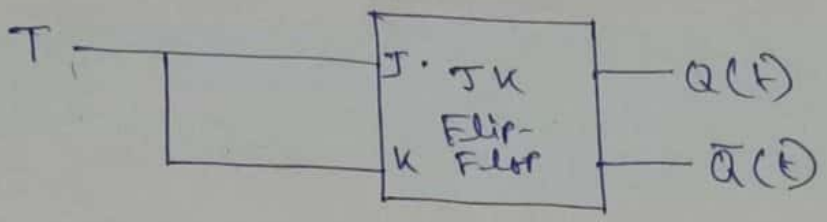

T flip flop using J-K Flip-flop.

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