D Flip Flop

D	Q(t+1)
0	0
1	1

SR Flip Flop

S	R	Q(t+1)	Description
0	0	Q(t)	No change
0	1	0	Reset
1	0	1	Set
1	1	??	Undefined

JK Flip Flop

J	K	Q(t+1)	Description
0	0	Q(t)	No change
0	1	0	Reset
1	0	1	Set
1	1	Q(t)’	complement

Basic Formulas:
V=IR
P=VI
E=QV
I=dQ/dt
Work in joules
Power in joules/s (watts)
SRS-positive current always towards neg.

Resistivity
$R=\rho L/A$
A-cross section (πr^2)
ρ-resistivity
L-length

X	Y	AND	OR	XOR	NAND	NOR	XNOR
0	0	0	0	0	1	1	1
0	1	0	1	1	1	0	0
1	0	0	1	1	1	0	0
1	1	1	1	0	0	0	1

Average and RMS
$RMS_{sine}=x/\sqrt{2}$
$RMS=(root(mean(\pi x^2)))$
$t=2\pi/\omega$
$f=1/t=\omega/2\pi$

$R_{series}=R_1+R_2\ldots+R_n$
$R_{parallel}=(R_1^{-1}+R_2^{-1}\ldots+R_n^{-1})^{-1}$
$R_{2parallel}=(R_1 x R_2)/(R_1+R_2)$

Same for inductors, opposite for caps

EMF
$F=n\pi BI$

F-force (N)
B-magnetic flux (Wb/m^2=tesla)
I-current (A)
π-length in flux (m)
n-number of wires in flux
I-charge x velocity
Right Hand rule-motor
Generator makes for –B

0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F

Capacitance
C-capacitance (F)
Q-charge (coul)
V-voltage
E-energy (J)
ε-permittivity (dielectric constant)
d-distance between plates
A-area of one plate
I=dq/dt
$\varepsilon_0=8.854x10^{-12}$ F/m

$C=Q/V$
$E(t)=.5Cv^2(t)$
$\varepsilon=\varepsilon_r\varepsilon_0$
$C=\varepsilon A/d$
I=C(dv/dt)

MOS
pMOS inverting (arrow out)
nMOS not inverting (arrow in)
pMOS are on the V_{CC} side
nMOS at ground

Diodes
$I=I_s(e^{38.5v}-1)$
Photodiode
$I=I_s(e^{38.5v}-1)-I_s$
Zener power supply:
$I_{max}=(V_s-V_z)/R$

Inductance
f-flux (Wb/m^2=tesla)
n-number of wires
L-inductance (H)

v=L(di/dt)
$\Delta I=(1/L)\int_{t1}^{t2}v(t)dt$
v=n(df/dt)

Magnetic Field Intensity
H-magnetic field intensity
μ-permeability

$\mathbf{B}=\mu\mathbf{H}$
$\mu=\mu_0\mu_r$
μ_0-$4\pi x10^{-7}$ henrys/m
n-number of turns
l-length (m)
l_g=air gap length

electromagnet w/o air gap
$B=\mu nI/l$

Electromagnet w/ air gap (approx.)
$B=\mu_0 ni/l_g$

BJT
All currents entering:
$I_B+I_E+I_E=0$
$V_{BC}+V_{CE}-V_{BE}=0$
Load Line:
$V_{CE}+R_C I_C=V_{CC}$
$I_{CMAX}=(V_{CC}-V_{CESAT})/R_C$

Off:
$V_{BE}<V_{BEON}$

Active:
$I_C=\beta I_B$
$V_{OUT}=V_{CC}-I_C R_C$

How to find saturation voltage:
When input current*beta= saturation current
Saturated:
$I_C=I_{CMAX}=(V_{CC}-V_{CESAT})/R_C$
$V_{CE}=V_{CESAT}$