

تقدم لجنة ElCoM الاكاديمية

دفتر لمادة: **الكترونيات رقمية**

من شرح: **د.رولب طوالبه**

جزيل الشكر للطالبة: **روند قطيشات**



Subject:				1 2018.
¥ 2_5	Diode	Resistor Log	ic (D.R.L.) 2-	L2
× –	•		110	
(NDCT.	2 (ал) а.И. – д. а.И.	
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	DA ,		Hi big b	Logic 1
VINA H o		-> Diode AN	D.gate.	
H O	41-0.7-	(new 171 -	DAK >VKTY	V. D. Con) =
U THB . H		Vout to	Bodo Marija ana se	·····
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,А	B	output		1. <u>e-</u> 1
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¥ - VI	c+l	1 + VINB = 0	: ashait wa	
	H. 1. v	A.L. T. the	e or yT]
	V =	VIN-VD	C	
the second second				
	N	> Vp (on)	→ on → oPP UIn ⁺	
1152 0 V - 2 0V 	×	<	$\Rightarrow oFF + n$	
1				T Create
		(re) d b	e sell	·····

2

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1 + 1 Subject:......2.....on VDC - VIN Z VD (on) VDC-VD (on) ZN. * Any or all inputs Low. 3-1- VIN < VDC - VD(on). 5 corresponding diode is on. Vont = VD (on) + VIN. if V_T_n = 0 > vont = V_D (on) = NoL $I_{R} = V_{DC} - V_{OUT} = V_{DC} - V_{D}(on) - V_{In}$ R6 6 * All populs high. (all diade off) VIn > VDC - VD (on). All Diodes off. TR =0, Vout = VDC = VOH. 11 × 11 × Vort slope = 0 Slope -> A vout A vin VDC Jourthigh dM = N cVD (on) VDC - VD(ON)Volon) V.T.W = 1 VDC - VD (on) S Notebook R A Т S

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6 Subject:...... 1 1 Diode OR Gate Diode cipi Input sue Estin DA Vout. D VIn > VD (on) => O.N. VIn < ND (on) => off. UTAB PB. -411 R B lout. 1 H H () All input Low. (All Diock opp). TR=0 > Vout =0 = Vol, VIn < VD(on) 2) Any or all input high (corrisponding didoe on) $V_{out} = V_{III} - V_D (on).$ $V_{III} > V_D (on).$ $\frac{T_R = V_{out} = V_{t_n} - V_{D_n} (on)}{R}$ R AV 1 V · · in the second second S Notebook R T A

0 0 Subject: 4 Voit * VIC 8- Nour Ş stope=0 Stope = 1 -<u>6 🖉 -</u> É VD (on). 6 * Logic Function >> A or B. * Example 8-(2.3) • VDC O if VIn A is higher than DA VIn B Hby I V H Show that DA 95 off VID A K UJn.B. UnA = 11+ VINB. N B () Assume DA ON N AFIN THAN A Vout = VDA + VIDA = 0.7 + VIDA. VBR = Vout - VIA B. = 0.7 + VIn A - VINB = 0.7 + 1 + VI/B - VI/B Т A S R S Notebook

ubject:	5			/ /	
N	D.R. = 1.	7, Inappl	icable and	assumption	that Da
	15	on 15 1	1 Correct.		·····
		DA is	092		
2	Assume	DBon.			
	Vout =	UINB +	<u>VD (on)</u> ,		
	UDA =	Vout -	ν τηΑ.		••••••
			106m) - (
			s	d IN an	
. 1. 2		= UINB	+ Up Con1 -1	- UZNB	
	UDA	A _ 0.7	-1 = -0,	3	
// X			DA OPP	and assump	tion that
į		Dg is			•••••
		-	÷i c	i	
EI I		VINA = VIL	1.B. 250 pi	ی دیشخلی لا	J Ul
F.L.					
<u>+</u>]	e v		<i>T</i>		
	e i 25.3		1.11		
*			1 451 1 7 4		
*			1 1/1 1 1/1 1 1/1 1 1/1		
*					
*					
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			nt na si na si Na si na s		

Subject:		4/2/2017	
A 2.6 Level Shifted DRL 8- Nont.	Nont	/	
UX only VIII	VD (on)	VIN.	
	°D (on)	anna an tha	
· Degradation & recluction o;	2 Increace	of Vont b	¥
VD (on) with respect			0
Volar	ن حفر لانا (تى تېلىش ريىيى م	D
* Level Shifted AND Crat	3.8-	tuy.	
			c
	<u></u>	S RE	
D All Input high VIN > VX - VD (orl:	N + . A	DIV	
Both Diode off.			12 Vout
$T_R = V_{CC} + V_{EE} - V_{E}$		DIB VX	J & RL
R _H + R		diode.	-VEC
Vout = IR RL -VEE OR V	out = Vcc +	TO PH - NO	
2) Amy soput Low.			
$V_{T_n} < V_X - V_D(on).$			
Corresponding Input Diod	c is on.		
		2. og 5.	
S T A	R	S Notebook	

ıbject:7		/ /
	·····	the
<u> 5 Volt = 1 Vx</u>	- V.D. Conl Cfrom eqn. 1)	
	- VEE JOH	51ope=0
E	in the second	
	- VEE Jour	Slope=1 Vx - Volon!
	Slope = 0	
	Stope = 0	
Ū V _X	> Vp (on) - VEE	br on.
16.0.18	K X 12 KIN	tropolitik da 70
2.a V7	n + VD (an) > VD	
·	99	
	VIn > - VE	E
	<u>y (iv) av - rokert</u>	sk <u>j</u> T
- VIn	- UDKON) + VDL (00)	+ Vout = 0.
•	they = NIV	1
	i k sta	and the state
2.b	VIN < - VEE.	
	$v_{x} < - v \in E +$	VD (on), DL is off
		VD (on), DL is off
	$V_X < - N EE +$ $T_{RL} = 0$	VD (on) , DL is off
	$v_{x} < - v \in E +$	VD (on) , DL is off
	$V_{x} < - N EE +$ $T_{RL} = 0$ $V_{out} = T_{R} R_{L} - V$	VD (on) , DL is off EE. = - VEE,
	$V_X < - N EE +$ $T_{RL} = 0$	VD (on) , DL is off EE. = - VEE,
	$V_{x} < - N EE +$ $T_{RL} = 0$ $V_{out} = T_{R} R_{L} - V$	VD (on) , DL is off EE = - VEE,
	$V_X < - NEE +$ $T_{RL} = 0$ $V_{out} = T_R RL - V$ ifted or Gate 8-	VD (on) , DL is off EE = - VEE,
	$V_X < - NEE +$ $T_{RL} = 0$ $V_{0ut} = T_R R_L - V$ ifted or Gate 8-	VD (on) , DL is off EE = - VEE,

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		BL.	J.A.R.H.
VInA -		VX	L Vou
	DTA	Level 5	shifting
V.InB.		2	
1 1 3 4 - 4	DIB		
		F RL	
		a state	
① All &Input			
	1	.). a.d	V in it
Both Input	t diod es	off,	
<u> </u>		n C V	
I _R = Ncc	+ VEE -	VD (on)	
			-
Vout = Vo			<u>/</u>
= N1			
<u>lla ei all jan</u> anzaa	ι	1	
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	10		
t t		t.	······
L	+		Vicc
	X+VD(0n)		vcc
		Noh legn 2)
	2	J	

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Subject:9			/ > /
<u>.</u>			
() VIn >	· VX + VDT	(an) (Any	y or All enputs
Corres	ponding Input	diodeCo:	viduets.
	$J_X < Vcc - V$	DL (ON).	CDL is onl
<u>a.</u>	VT - VD - K		
		an)	Y.D.L. Kon.)
	VIn	K NCC.	
			<u>+</u>
2.ь	VIN	> Vcc.	(DL OFF)
		<u> </u>	i na In M
······	No.V.	t=Vcc	
			Provide State
* Example			
* 2.7	Clamping di	ode.	
* 2,8			and a second
torration	1	a	+ V.
2 ro blem * 2,18 3-	4.4		
For - 4 <			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Draw	V TC.	VIn -	DA VX DL
CNIV D			
D.			
$T_{R} = 8$	<u>- VD (on)</u> = 2k		
Т	A	R	S Notebook

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6/2/2018 جکن وجر زیم 80 gale. Nout -4 1k +(3.65m) -4 $2 - VI_n < V_x - V_b (on)$. (DI is on). 2.9 UIN > -4 = NDC, DL ON. Vont - VIn. and the second sec 1 2, b $V_{T_n} < -4$ DL off ÿ -0.35 17 Vout - - 4. 25 2 TT 2.6 110R. X=CD D Logic Function. R, 7 - CD + ABE. D J=AB B A S Notebook R A T S

Subject:..... 1 * Chapter 4 & Interoduction to Bipalar Digital Circuit Su al Analysia of BJT (operation modes) Tell Commence O cut 6ff TR (B-E) J Z Both Veverse (B-C) J baised currents = 0. 2 For ward Active (FA) (B-E)J Forward (B-C) J- Reverse V_{BE} (EA) = 0.7 $T_c = \beta T_B$ $I_F = T_C + I_B = (1+B) I_B$ Reverse Active (RA) 1 Icg (B-E) J Reverse (B-C) J For word. A CARACTERIA S Notebook R 5

Sabject: 12

= IC = IB - IE arris JE la aubel el RA. نع بعكس استارة في FA -IF = BR IB. $-\mathrm{T}_{\mathrm{C}}=(1+\beta_{\mathrm{R}})\mathrm{T}_{\mathrm{B}}.$ BR << BF. (4) Saturation mode. (B-E) J & B-C) J → Forward. UBc(sat) TE = Tc + TB. + VCE (soft) $T_{c} \neq \beta_{F} I_{B}$ TC = O'BE IB , O'KI $U_{CE}(sat) = 0.2$ $V_{BE}(sat) = 0.8$. $V_{RE}(S_{AH}) = V_{BE}(S_{AH}) - V_{CE}(S_{AH}).$ = 0.8 - 0.2 = 0.6 V

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A S Notebook

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Subject: 3 1 1 * Example 4.1 Vcc = 5 ⇒Qo is in soft mode. RB = 5K = Rc=640 Pend IR, Ic and or a-0.7 -5 + TB RB +0.8 =0 0.8 $T_{B} = \frac{5 - 0.8}{5} = 840 \text{ MA}.$ $T_{C} = 5 - 0.2 = 7.5 \text{ mA}.$ Ic = & BE TB. $\sigma' = \frac{T_{C}}{\sigma' \beta_{E}} = 0.137.$ 4.2 Example VBT V815 Q5 (EA) VET. QI (Sat) Vgc VCIO VE,5 VBO JE.O. S. Nentbook R A

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Subject: 14 VE, 0 = Zero: $V_{B,0} = 0.7$ VE,S = 2 VBE = 1.4. V8.5 VE, T = 2 URE (FA) - VE, E (sat) = 1.2. $U_{B,T} = U_{F,T} + U_{BFT}(sat) = 1.2 + 0.8 = 2.$ Read Exemple (4.3) In verter. 3-¥ 4.2 BJT C.E. (common Emilter). RB1 - Uout ି ଦିଂ VIn VIC Edge of Conductance (EOC) off VCC = USH of saturation (Fos) FA transition. Edge Vol UIn. VIH VI. VOH -> VIN < VBE (FA) $Q_0 \circ PP$, TB = o = TcVout = Vcc = VoH R A S Notebook T S

Subject:....

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1 1 2 VIL (input that turns Q on FA). UTL = UBE (FA). Since initially TR=0. at Edge of conductance. As input increase, IB increase, and Ic increase, and Vout decrease. 3- For higher input. , Qo Saturate, and Vont = Vol = VCE(soff). * VIH (voltage at which Qo saturates Eos) $UIH = T_R (Eos) R_B + UBE_0 (Sat).$ $\frac{T_c = U_{cc} - V_{cE}(s_{at})}{R_{c.}}$ $\frac{T_B(F_{OS}) = T_C(\sigma = 1 \text{ at } F_{OS})}{\beta_F}$ VIL, VIH, VOL, VOH = Critical Voltage. 1 State Martin The Antonio Martin

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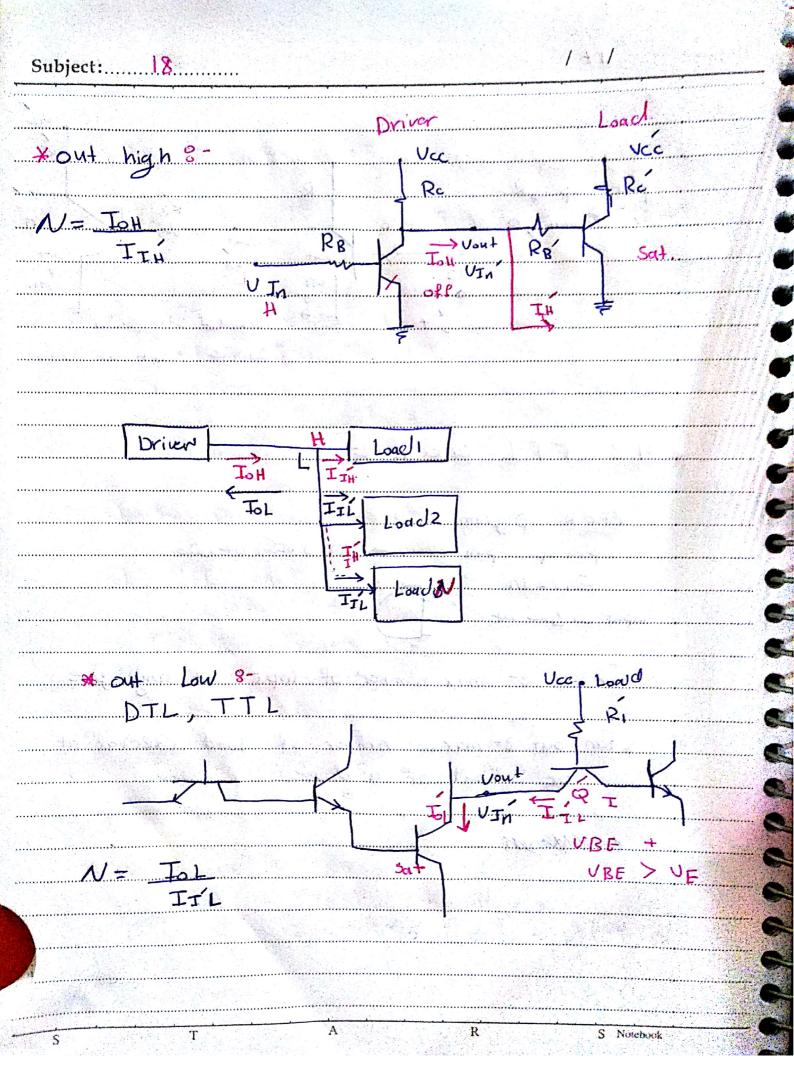
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S Notebook

8/2/2018. * Example 4.4 Vcc. = 5 RC. = 14. BF = 60Find the high Low noise margins. UOH. High Noise Margin (HNM) = VOH - UIH Low High noise margin (Hnm) = Vol VOL- UTL Sefety margins max a Pfordable. VIL VIH noise. UOH = Vec = 5UoL = 0.2 $V_{TL} = 0.7$ $VI_{H} = 5 - 0.2 lok + 0.8.$ -1 10 (60) -= 1.6 HNM = VOH - VIH = 5-1.6 = 3.4 $LNM = V_{01} - V_{11} = 0.7 - 0.2 = 0.5$ S T A R S Notebook

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Subject: 17 Vce Ru pull up _ Rc. Rc RB RB 1. down > Qo Usut Sat sort on. UTA. off F.A لى ليشعل عاد لرا ت Jew int VIAH it V * 4.3 TTL circuits 8-Block Digram. رجن را مکتان و ۲۳۱ pull up , pull down -Fan - in Input c * Fan -in 8- max number of inputs at any gate. 1 * For -out 8- maxium number of Load conected at the output of a driver. outligneet R S Notebook A \$



1 1 * 4.4 Level shifting BJTo 3-4.5 Discharge path and Base driving cets. and the second * Exempte prop (4.12) VBE(Sat) = 0.75 $U_{CE}(soft) = 0.1$. B = 100 $UT_{B} \xrightarrow{RB} UB:$ $UT_{B} \xrightarrow{T_{RB}} T_{B}$ $2_{0} \times \frac{R}{2} R_{D}$ $UT_{B} \xrightarrow{Vout}$ a) jf UIN=5 find IR. Assume F.A. $T_R = T_{RR} - T_{RD}$ = 5 - 0.7 - 0.7 + 5 = 0.995 mA.5K 20 k. $T_{c} = 100 \times 0.995 = 99.5 \text{ mA}$ UCE = UCC - IC Re = 5-9.95 (1.5) = -Ve. Set 1 S Notebook R T

Piel. UB = VBE (Sa F = 0.75. $T_B = 5 - 0.75 - 0.75 + 5 = 0.563 \text{ mA}.$ 5k 20k UCF = UCC - IC RC 01 = 5 - Ic (1.5). $T_{C} = \frac{5 - 0.1}{1.5}$ b) is Q is sat mode. c) UIL and UIH. VIL (Foc). Initially IB =0 TRD = TRB. $T_{RB} = T_{RD} = 0.7 + 5 = 0.285 mA.$ 20K and the second U In - UB = TRB. $= 0.285 \times 5 + 0.7 = 2.125 V.$ S Notebook

1 1 Subject:..... UTH [Fas] G=1. VIH = TRB RB + URE(sat). IRB- IB + IRD. $T_{B} = T_{C} = T_{C} = 5_{-0.1} = 0.0327 \text{mA}$ (1.5) (100) <1) $T_{RB} = 0.75 + 5 = 0.29$ $T_{B_{R}} = 0.29 + 0.0327 mA$ $U_{I_N} = I_{B_R} R_{B+1} o.75.$ T A R

11/2/2018 Subject: 22 * Chapter 5 RTL 3npn 3- in series AND/NAND. Vcc inperand NOR/OR. Te Vout Pnp 3- in series NOR/OR RBI in paralleli AND IAIAND UIN (parratel) NOR. In general 3-Vout - Vcc - IRC RC. IRC = Z IC, i = IC, + IC2 + · · + Icn Ing out. Ina 0 0 () All inputs Low All Martins to tranistors will be off Vout = Vcc = H S Notebook R A

1 1 @ Any or all inputs high Corriesponding transistor saturates. Vout = VCE (sat = L 5.3 Basic RTL NAND Gate. 2 R c Vout = Vac - IRC RC. RB2 Vout. if quand Q2 in UIn2 -1-K F.A. P.81 $TE_1 = Tc_1 = TE_2 = Tc_2$ $UT_{n_1} = V$ = IRC. K JB UPRILLE 2- input NAND Gate In I Inz out 0 0 1 σ 0 1 1 0 () Any or all inputs Low. 1.a, all Low, all Ps off. Vout = Va R S Notebook

111 L.b. Try Low, TN2 high Q. off, Q2 has no link. to ground and is off too. Vout = Vce = high I.C. Try high, Tre Low. Q2 OFF, Q. Not power (also off) Vout = Vcc = H. 24 both high when Q1, turns on (F.A). $V_{71} = UBE(E,A)$ when Q2 turn i $U_{TL_2} = U_{B,E_2}(FA) + U_{CE,1}(Sat)$ Q1 Sat wrates at UIH1 - TB, RB1 + UBE, (sat) Q_2 is at $U_{TH_2} = T_{B_2} R_{B_2} + U_{BE_2}$ (sat) + UCE (sort). S T A R S Notebook

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then Q, Q2 Saturates (Pnput high). Unt = 2 VCE (sat) TB UP VSI TB UP VSI TB * Multi - input NAND Gate 8-Usut = Ucci - IRC To VCC UOH = UCC. Re Red NO 102 - EUCE (sat). RBM RB Qn - NUCE(sat) UINN ------RB2 UIW2 ª Q.2 RBI Q.1. VINI · Example 5.1. 9 Find Fan in (n = ?)For Load UBE (F,A) = 0.7. UCE (Sat) = 0.17 V for driver. يرزم يحين . off. NUCE (sat) < UBE (F.A) J n < 0.7 = 4.12 Zep sie $\sqrt{-1}$ 1. and Jel S Notebook R

1.1

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Subject: 26 13/2/2018.
L
5.4 RTL Fan-out & Vice
Re voit
N= ToH IIH RB Vout
IH VIN
⊥ ⊥ _{IH}
- Fan - out Found when 0/p high when output Low.
Load BJT.s are off and Input current will
be Zero.
For Driver to be high, Q must be off, for
Q to be off input at driver must be. Low
K TRC = TOH = N IIH ITH = IRB
· Sat 13 q ipi ~1 cit 1 cont = UÍNH Pil
UbH is limited by VIH for Q to saturate
vout = UIN = Ucc - IRC RC.
$T_{Rc} = T_{OH} = \frac{V_{CC} - V_{OH}}{R_C}$
S T A R S Notebook

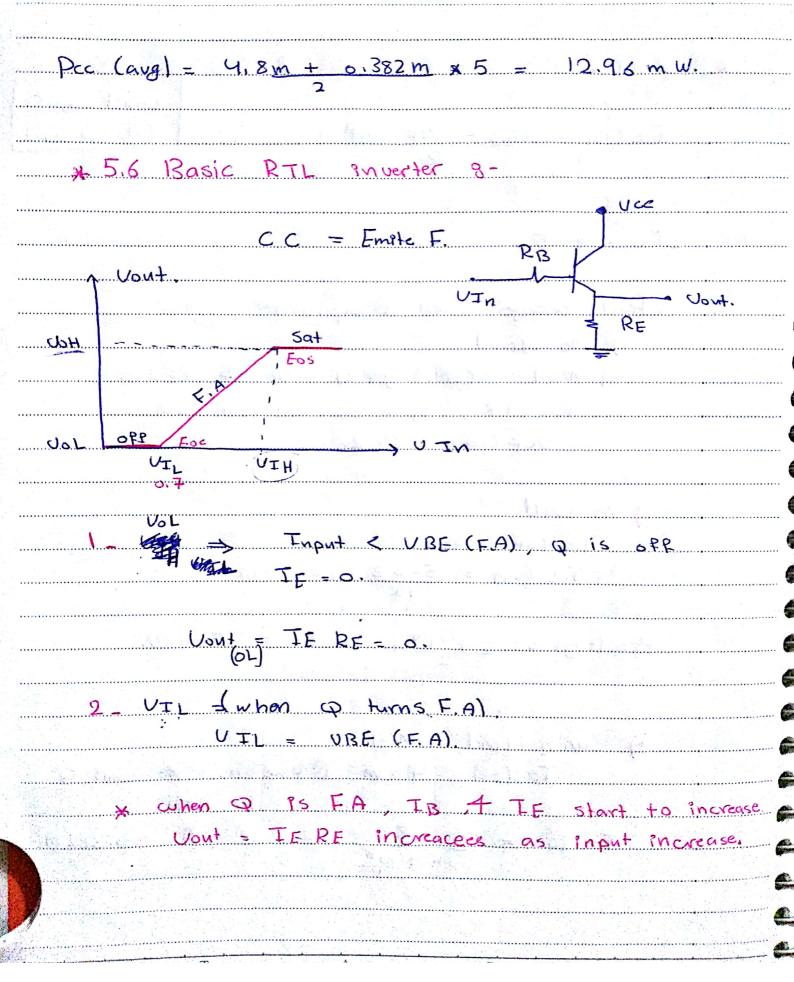
1 1 TH = IRB = Usit - UBE (sat) RB. $N = V_{CC} = V_{OUT} + \frac{RB}{RC}$ Vout - VBÉ(sat) RC Jout - UIH = IB (EOS) RB + UBE (Sat) $T_{R'} = V_{cc} - V_{cc} (sat), (s=1) at Eas.$ R'2 (B) * Read Example 5.2 (N=12,1 × 12) * RTL power Dissipation. no Load output high (Input Low) Q is off. Toc (OH) - TRC = 0. output Low (input high) Q is saturation T_{cc} (oL) = U_{cc} - U_{cF} (sat) Rc and the second se S S Notebook R T A

1 1 -Pcc (avg) = Jcc (oH) + Jcc (or) Ucc. * with Load 3output high, Q (Driver) is off, Q'(Load) saturates TRC = The N IB = Tec (oH) $= N \left(V_{TH} - V_{RF} \left(cat \right) \right)$ Vice - IRE RC' - URE (Sat) RR. IRC + IRC RC N = VCC - UBÉ (soft) N Ré RB IRC = VCC - UB(SOH) N (1+NRC) RB' = UCC - UB (Sat) N (RB + NRC) $\frac{Vcc - UB(sat)}{\frac{RB'}{4} + Rc}$ A R

Subject: 29 1 1 * out Low !-Load - off Tec (ol) - Vec - Ver (sat) -Example 5.3 * find avarge power Dissipation. a) no Load. b) N=1 (one gate), Vac=5, RB=10: BC = 1 K, BF = 25, VBE (sat) = 0.8. $V \subset E (s \alpha t) = 0.2.$ a) no Load $T_{cc}(0H) = 0.$ $T_{cc}(0L) = 5 - 0.2 = 4.8 \text{ mA.}^{11}$ $P_{cc}(avg) = 0 + 4.8 m \times 5 = 12 m W.$ b) with Load N=1 Tec (oL) - 4,8 m (same as no Load Q' is offi $T_{cc} (oH) = \frac{5 - 0.8}{1 + 10^{k}} = 382 \ \mu A. = 0.382 \ mA.$ S Notebook R A

Subject: <u>30</u>.





1 1 Input keeps increasing with Q saturates at UIH. (3) UOH => UDH = UCC - UCE (SOAH). EOS. $\neq UTH(E_{oS})$ UTH = IB RB + UBC (sat) + UCC $I_{B} = I_{E} E_{os} (\sigma_{el})$ $T_{E} = \frac{V_{CE} - V_{CE}(s_{e})}{R_{E}}$ UIH = UCC UCE (Sat) RB + UBC (Sat) + UCC B+1 RE 6R UTH + TB RB + UBE (sat) + TE RE =0 $UI_{H} = I_{B} R_{B} + U_{B}E (sat) + T_{E} R_{E}$ VIH > Vcc > sat Sys was لازم تعطيه عداينة المل R

5 15 / 2 / 2012. * Example (5.4] 3-UB E (sat) = 0.8, UBC(sat) = 0.6 Ucc = 5 $\beta F = 25$, $R_B = 10$ K. UIN $UI_{L} = 2.7$ Van RE $U_{0}L = 0$ $V_{0H} = 5 - 0.2 = 4.8$ $UI_{nH} = \frac{5_{-0.2}}{26} \left(\frac{10}{1} \right) + 0.6 + 5.$ --= 7.4 -5.7 Basic "OR" and "AND " Crates. OR Gate -RB2 F RB1 PB" Q, UInz 6 イ Qu UIn. Usut. JRE F RE $I_{RF} = \sum_{i=1}^{2} I_{Fi}$ Ubut = TRE RE = VCC - VCE R S Notebook A T

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Subj	e	ωı		•	•	•	•	•	•	•		٠	S. 2	•	•	•	٠	٠	÷	•

1 1

* All inputs Low (Logic o) All Q's off $T_B = T_E = T_{RE} = 0$ $V_{0} = 0$ × Any (or all) enputs high (Logic, 1), corresponding Q serturates Vout = Vcc - VcE(sat)In, Inz Jnz out 0 0 0 0 0 0 1 1 Lill Law March Street 0 1 VCC Ren . p on * AND gates 8-In general PB2 Vout = IERE. UTWE - UCC + N UCE UIn, RE S T A R S Notebook

61 -Subject: 34 1 1 --* Any or all Inputs Low, 9 Corresponding Q is 6PP -Uott = 0 (Logico) TRE = 0. * All in puts high 2_ Input And Crate PE Q2 is F.A and Q1 Sat Unit Uant = UCC - UCE, (F.A) - UCE, (Sat). 92 both Saturates. USH = Ucc - 2 Uc E (Sat) TP N transistor's 6 UOH = UCC - N UCE (Sort) VIH Logic input at 1 Logic output at 1 -----In, Inz Inz out. 0 0 0 0 0 1 0 0 1 0 - 1 S Notebook R A

1 1 Vin -> high 3 Vout = high (sat) 3 1 out mueste 3 9 Vout TN 3 TI with active pull-u VGC REP + RBS = RBO - RB Rc For Qs and RBS RBP Q_{ρ} $\pm q$ In off ODDerate Sat at the Н RBO Sat Same time 1 OPP pull up - active Pp de is high man ail pullup passive anound as to USA as active and its al 2 R A S Notebook S T

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M. 1 1 Subject: <u>36</u> * Rep, Qp => Active pull-up ect. Qo ->pul - down, Sink, -> (Load) -Uput (Low) Load (098) (m Sat a' H Qo is print & -0 6 Manager Colly input high, Qs, Qo are ET. Satura ling. -- UCE, s (sat) + TB RBP + UBE, p(?) + Ver, (sat)=0 - $l_{B} = - V_{BE, P(?)}$ RBD 6 0 " Qp => off. Ċ * guput Low, Qs, Qo => sPP. 6 0 Is high enough to Saturate Qp. لاتم تا كدان الم الجم الم المع من خلال حسارة TB 0 UCE 2 Co. VCE = +UE => F.A -VCG = - VC = Sat. -بهدين بنوي فكلا ويتبع فالتدار and a second R T A

••••••						
* 5.8	Cont.			<u>_</u>	0.1455	<u>, , , , , , , , , , , , , , , , , , , </u>
Rep =	= 2.1 RC				O Vee	
	1.1		Rc		~	Rep
		(1996)	RB		RBP	Sat (20)
		U.I.n.	T	J Qs off		Qp 6FP)
		Н		मु ५व		H L
			t and	124 -	RB0 K	Q0. 7 088
			Class A. A. a	si - (a. j	<u>.</u>	L sat
Ic	c V	adV y				<u></u>
Re		Rep	••••••	Re Z		
	RBP		RB	s		5
PBS Q		Vont I	>-/	- (9,		RBp'
Ţ			I IH	Ŧ		1
		Q.6				
		<u>-</u>				~~~~K
					R _B	•
× Fan	_out is	<u>Vimited</u>	by	Vout whi	ch is	límited
by	VIH	-			<u>, 41 - 61</u>	1
	= <u>Тон</u> т _{тн}				<u>)</u>	-

1 1 JOH = N IIH = 2N TB for simplicity Icp = TE = Ucc - UcE, p (sal) - UoH Rcp $= 2N \left[\frac{N_{OH} - V_{BE}(S_{C})}{R_{B}} \right]$ N= Ucc - VcE (sat) - vout RB Usut - UBÉ(sat) 2 Rcp Vout = UTH = IB RB, UBE (sat) - VCE - VCE (sat) RB + VBE (sat), D-1 BE is used fan out 12 land the sec 12 with Load, - Rep - Qp => active - pull (sources more current for Load). - Read Example 5.5, 5.11, 4-20, 4.4, 5, 17, 4.22 * S Notebook

Subject: 39 . £ <u>5.32</u> Rep = 100 , Re = 3.6K 1, Rap = 1.5K RBS = 1.5 K BF = 100..... Find IBP, ICP, Vout. F_{0} N = 4. a) $V_{\text{In}} = o V$. N= Vcc - VcF (sal) - Vout RBP 2Rcp. Uout - UBE (sat) $4 = 5 - 0.2 - 0.001 \times \frac{1.5}{2 \times 100}$ Vout - 0.8 Uout = 3.4 V. $T_{R_{c}} = T_{B_{p}} = 5 - 0.8 - 3.4 = 0.457 \text{ mA}.$ (1.5+3.6) K $I_{Pcp} = 5 - 0.2 - 3.4 = 14 \text{ mA}.$ 100 S Τ Α R S Notebook Scanned by CamScanner

1 . 1 Tec (OH) = TRC (OH) + TRCP (OH) = 14 + 0.157 = 14.157 mA b) UTN = 5 Uolt. Qs 4 Qo sat ap > off $1_{Rc} = V_{cc} - V_{cE}(sat) = 5 - 0.2 = 1.33 mA.$ 3.6 K RC L.R.B.p. - O. TRCD-0, Icc (oL) = IRC (OL) = 1.33 mA. (down) = crown (won) Uout = VCE (oL) = 0.2 5. Vo & Find the Aug power dissipation. Pcc (aug) = Jcc (oH) + Jcc (oL) Ucc $-1.33 + 14.16 \times 5 = 38.7 \,\mathrm{mW},$ S Notebook R А T

* Chapter 5. Diode tennsition Logic (DTL). 6.1 Basic DTL Q. Ucc R_B UTn VTn $VT_N \prec V_X$, P_T on
$\begin{array}{c c} \hline G.I & Basic & DTL \\ \hline \\ & & & \\$
U_{Tn} V_{T} D_{T} D_{T} $V_{Tv} < V_{X}$ D_{T} D_{T} D_{T} D_{T} D_{T} D_{T} D_{T}
A TO AND A LAR AT 2 A A
$V_{\mathbf{X}} = V \mathbf{D}_{\mathbf{I}} + V \mathbf{I} \mathbf{N}$
$U_{\chi} = U_{DL} + U_{\beta}E(FA)$
\star VoH \rightarrow VX < VDL + VBE (F.A)
D_{L} , Q_{o} of f
$T_{RC} = 0$, $U_{OWH} = U_{OH} = U_{CC}$
V_{DL} + $UIN < U_{DL}$ + $U_{BF}(F,A)$
$UI_{N} < UBE(F,A)$

Subject: 42 VTC & Vout. $H \wedge H = 4.2$ I N M = 0.5(Uce) Vot off -> FoC. F.A (sat) UCE (Sat) on BE (sat) UBE (F.A) UTI × UTL => Qo turns on when $U_X = U_{DL}(on) + U_{BE}(F,A)$ UIN + UBECONI = Uplon + UBE(FA) $UT_{n_{1}} = UBF(FA)$ × Qo saturates when UIH = UBE (sat) Vol = UCE (sat) S Notebook R A T S

1 UIN > VX >> DT is Off. Riz must be Small for Qo to saturate × NAND Sate. VCC IN2 out IM RR.ZRc..... Inverte Vout 0 J.U.T.n. 0 0 UIn KI ANP × 6.2 Modified DTL Additional Level - Shifting (LNU RB . Re RD = - VEE S T A R S Notebook

6 0 1 1 Subject: 44 C C/ * RD, UEE : discharge path of Qo when it turns @ From Sat <u>C</u> _ UEE can be replaced with Crud (RD decrease) 1 ب المحافظة على سار. لا نه ولي بيني e 9 DL2 to improve LNM. e P - UTN - UD'T + ZUDL + VBE -0. 9 9 1) \times UoH Qo off $(U_{T_N} < V_X, D_T on)$ 6- $U_X \leq 2V_{D1}$ (on) + U_{RE} (F.A). C ¢ <u>_____</u> $V_{TN} < U_{DL}(on) + U_{BE}(F,A)$ C UoH = Ucc. L. Restriction Foc >> UTL = UBE (F.A) -> UDL (on) Eos -> UTH = UBE (sat) + UDL (on) $U_{02} = U_{CE} (sat).$ 2) UIN Y VX, DIOPP R Po still Satis For RB Small. R R S T A R S Notebook

1. _الارتاع اعقاداً على حتمر شادرة عكن تبغير Uol (0.2) UTN 1.4 1.5 07 VIH * VHNH = 3.5 ULNH = 1.2 U > better than ULNN PN Basic DTL. * 6.3 Transistor Modified DTL. ↓ TE PRBZ CI-P)RB ST Þ Rc TB " I Q L UIn OPE DI UBL OPP Qol F.A TE OPP 1217 QL, Qo while GD UIN = 1.4 Will Clex * RD and the ground -> dic hange part. $\star P < 1$ $P = R_B + (1 - P) = R_B$ $N = T_0$ TI' S Т A R S Notebook

22/2/2018 $\times P = 1$, (1-P) $R_B = 0$ (short cct B, c) لم حزء علدي للتعن ساميره، PL acts Like a diode. 5_____ ____ \ * Input high, VC> VB. VILLAND - VERT V AND - LONG HILL VRC - Ve -> QL F.A. $-U_{T_{L_1}} - U_{D_T}(on) + U_{BE}(F,A) + U_{DC}(on) + U_{BE}o = 0$ * Example 5.1 Find UTC. Va - UOH 1 -- 1 Cl 0.2 13 13 14 (240 I 0) 1.5 1.4 $U_{In} < v_{x} (D_{I} \circ n).$ $U_{OH} = U_{CC} = 5$ $U_{OL} = 0.2$ $UT_L = 2 U_{BE} (FA) = 1.4$ $U_{IH} = U_{BE, L} (F, A) + U_{BE} (Sat)$ <u>≈ 1,5</u> 1 g 4. S Т A R Notebook

1 1. $X U_{TN} < U_{X}$ ³⁻ DI on U_{TC} UIN > Vx 3- DT off Power, Fan -out. 4 NAND Gate. g Ucc P.R. i Rc (I-P)Rg Z OL Noyt. φ_{o} DI DL 7 Rp True Inz out. 0 UIN 0 ١ 0 0 VINN * Any input < 2 UBE (F.A), Qo off. (at least DI on). Vout = UoH = Ucc = Logic H. > All input high, all DI's OFF Q2 Sat > Uout = UoL = UCE (sat) = Logic Low. $V T_N > U_{B,E_L}(FA) + U_{BE,O}$ (soit). S Т Α R S Notebook

1 × 6.5 DTL Fam Dout gVa TE,L IIR > Ic,L CI-PI (1-0) DI oft .Qo. DL RD IB,0 IE Driver C IRD -0 × Fan _out obtained at! Low out put for DI to be on. N= JoL 0 TIL $T_{T'_{L}} = U_{CC'} - U_{T'P}(on) - U_{CTE,o}(sat)$ (\mathbf{x}) RB. Jall RB. TTL Smal E. = I (PRB) of -> For power dissipation Per la TOL = TCO - TRC. - UCERO (SOH) - IRC/OL) Vcc 2) RC A R Т S. Notebook

1 1 Subject: 49 $T_{c,o} = \sigma \beta_F T_{Bo}$. $(\sigma = 1)$. $I_{B,0} = I_{E,L} - I_{R,D}$ TRD = UBE (sat) RD - UCC + TE PRB + TB, L (1-P) RB + UBE, (F.A) + $U_{p_L}(on)$ + $U_{BE,o}(sat) = 0$. $\overline{L}B, L = \overline{L}E, L$ PF+1. Topp (OH) = IE = UCC - URE, L (F.A) - UD, L (ON) - URE (Set) PRB + (1-A) RB - igonre * Less than RB - B+1 IE Estrix ,..... IE high -> Top -> high NA - Tot -> high * Read Example 6.2 N=54 × 6.6 power Dissipation. pcc (avg) = Icc (oH) + Icc (oL) Ucc. 2 $T_{cc} (oH) = T_{RC} (oH) + T_{p} R_{B} (oH) = T_{p} R_{B} (oH)$ From eqn () S T A R S Notebook

Subject: <u>5</u> 0	1 1
* $T_{cc}(oL) = T_{R_c}(oL)(0) +$	TARB (OL)
eg (2)	eq (3)
DTL NoR gate	2.
UINA UINB	VCC RC
U _{INC}	VCC RC Uout
Vont = Verwith Q sol	t. high and Is Triput & P - Low perts Tinput &
	5 bign
11-11 2 2 (1-1) 17-1	
<u> </u>	
A C JA	
s Schull - Eine eine seine	

No. Contraction

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Subject:.....5. 1 1 * Chapter 7 Transistor Logic (TTL) E B Main different between TTL and DTL that DT and DL IN DTL are replaced. TTL In general uses an active put act (higher Paus - out) TTL faster than DTL. * The most common families in TTL. 7400 series. $(\circ \rightarrow 7 \circ c^{\circ}).$ 5700 series (-55 -> 125 c°) 7.1 Basic TTL Inverter. passive pull-up $R_R \neq T_B(R,A) \neq RC$ - Lout TE (RAL U.B. IN UCE (Sat) Q I TC, I (RA) Q S Dull Jown AL Low input UBE (+ve) QI > provides Qo with current also if input is Low QI is a discharge path for Qo. S Т Α R S Notebook

Subject: <u>52</u>	1 1
	NIN
IB, I = Ucc - UBE, I (sat) - Uc	
₽ _₿ .	
IB, I high enough to satur	ate. QI.
UTN- UCE (sat) + UBE (<u>?) =0</u> .
UBE = UIN + UCE (sat).	
Qo off Tc=zero	Ubut = high.
	t fedt i Til
* QI operents in an	0
generates TE, This	IB enters Q-T and
Pn to current,	
Ic, I = IB,0 (LCat	ge) very small.
1 1 - 1	
V DOH -> UIN < U	

QT Set, Qo Off Jout = UbH = Ucc. VIL - UCE, I (sat) + UBE, O (F.A) Q. Foc, QI Sat.

Ala and a state of the state of

/ / (3) UTH = - UCE (sat) + UBE, o (sat).Qo Eos QI sat. 1 UoL = UCE (sat) 00 0ff Eoc 00 (F.A) $= \frac{V_{0L}}{U_{CE}(sat)}$ $= \frac{V_{0L}}{V_{L}}$ $= \frac{V_{1L}}{V_{1L}}$ $= \frac{V_{1L}}{Q_{L}(sat)}$ _____ TP input increases beyond UTH, at some point (Logic hign) UIN = UE, T > UB, TUBE, -Le (B-E) J is reverse biased. UBC, I = UCC - IB, I RB - UBE, o (sat). → UBC + Ve → QI man operates. in the RA mode. TE = B JB, I BR Uary Small. ایجام نیار معناما TC, Is (1+BR) IB, I cult R.A. e QI is high is power and suldx

Subject: 5.4 1 * 7.2 Comparison of Stored - charge Removal. 6 (between DTL and TTL) 6 DTL . Sat <u>V</u> OPP HR.D.... 5 90 went from Sat to off output went from L to H. Toput " H to L TD (Charge removal) = TD,D, DTL = UBE (sat) Ucc Rc F RB Qo QI UIn UIN = UE, I = UCE (sort) UBI = UBE & UCE (sat), $U_{c,T} = U_{B,C}$ (sat) Notebook D

Subject:......55

/ /

$U_{BC,T} = U_{BE,T} + U_{CE(sat)} - U_{BE,O}(sat)$
= 0.2 max
= 0.1 M9M.
but Less than UB,C (sat)
$\Rightarrow Q I q N F.A mode,$
IB, o (discharge) = IC, E (F.A).
$\overline{T_{c,T}} = \overline{B_{F}} \overline{T_{B,T}} = \overline{T_{B_{o,T}}} \overline{T_{L}}.$
VIn (Low)
IB, T = Ucc - UBE, T (E.A) - UEE (sut)
R_{R} .
-
$T_{Bo,TTL} = B_F \left[U_{GC} - U_{BE}, T(F,A) - U_{In}(L_{out}) \right]$
L PB
DTL C- activel
* TTE Encarge Kensual >> IDTL (Ch. Kensual)
tong .

Subject:......56 1/3/2018 * Example 7.1 3find factor of improvement of stored Charge removal (between FTTL and DTL). RD = 5K Por DTL RB = 2K For TTLOO $\overline{I}_{RD} = \underbrace{V_{REO}(SaE)}_{SK} = \underbrace{0.8}_{SK} = 160 \mu A.$ RD $TB_{0} = 50 \left| \frac{5 - 0.2 - 0.7}{2\kappa} \right| = 102.5 \text{ m}.$ Factor of pmprovement = 102.5 m = 640.6.160 μ 7.3 Basic TTL NAND Gate and the multi-emitter BJT. B UTAR E3. H S Notebook R

1 1 Subject: 5.7 NAND Crate Ucc RB S RC. UINA VCE(SAE). Any Input Low 8-UTN Z UBEO (F.A) - UCE, I (sat). Q2 off Vout = Vcc = Logic high. Q______Sat. \chi All input high 8-UBE, I - Ve -> QI in R.A mode. Qo Saturate Uart = UCE, a (sat) = logic Low. A B out 0 0 1 0..... 1 0 S Notebook R T A

Subject: 560 in I I 7.4 Standard TTL NAND Gate with TOTEM pole Cpull-Hp, pull down cct). Ucc. T_E , $A(R,A) = \beta_R T_B \approx 0$ LB (RA) RBZ RC Rcp OP (FA). Sat UIN2-DC, R.A DL J- OFF DC2 Po (sqt) L RD QP >> Elific pull and more current active provided at output. Qo => dis charge path. RD / Path. - Qs > Drive Splitter or Logic Priversion. Qs also feeds Qo QI = when Input Low acts as discharge path, also provide Qs and Qs with current.

Subject:		1 1
	n. Paput Is Low	
	$U_{TN} < U_{RE,S} (FA) = U_{CE,T}$ $Q_{S}, Q_{O} = OFP$	
	TB, p 95 enough run Q Rc, > Rcp -> VRC	p and <u>DL</u> but DURCP
	$U_{B,P} < U_{C,P} \Rightarrow$ $\Rightarrow Q_{P} = 9M = F.A.$	UB, C, p Ve.
	_ UIN + UCE, T (Sat) +	UB,5=0.
	UIN = UB, S - UCE, I	<u>(sat)</u>
	$Q_{s} \rightarrow on \rightarrow U_{B,s}$	= 0.7.
····· ›	uhen input is high 8-	
	QI, R.A modes. Qs, Qo Sat.	
	UB, P = UBE S (sqt) + UBE	=,0 (sat) = 1 Uolt.
<u></u>	ote × 9 p -> on run Up	$\frac{DL}{2} = \frac{1.6}{2}$
		R S Notebook

6 Subject:.....60 4/3/2018. Q 0 $UT C \Rightarrow QT Sat.$ 0 C power disipertion > QI RA e 1912 * 7.5 Standard TTL UTC -- UCC e E. Ra Z Re Z Re 6 Q.S..... 6 QI 6 Qs 6 - Jout. 6 Øo \$ RD 6 6 0 + at Low input Input < 2UBE - UCE (sut). 6 IPB = UCC - UBE, T (sat) - UT, N (Low) 6 RR-4.....(1. ÷. ÷. ÷. ÷. č. Lauge enough to saturate QI -Qs, Qo off. -IC, I = (sat) = IB,0 (leakage). Qp in F.A mode, DL on 0 S Notebook R A T 8 R

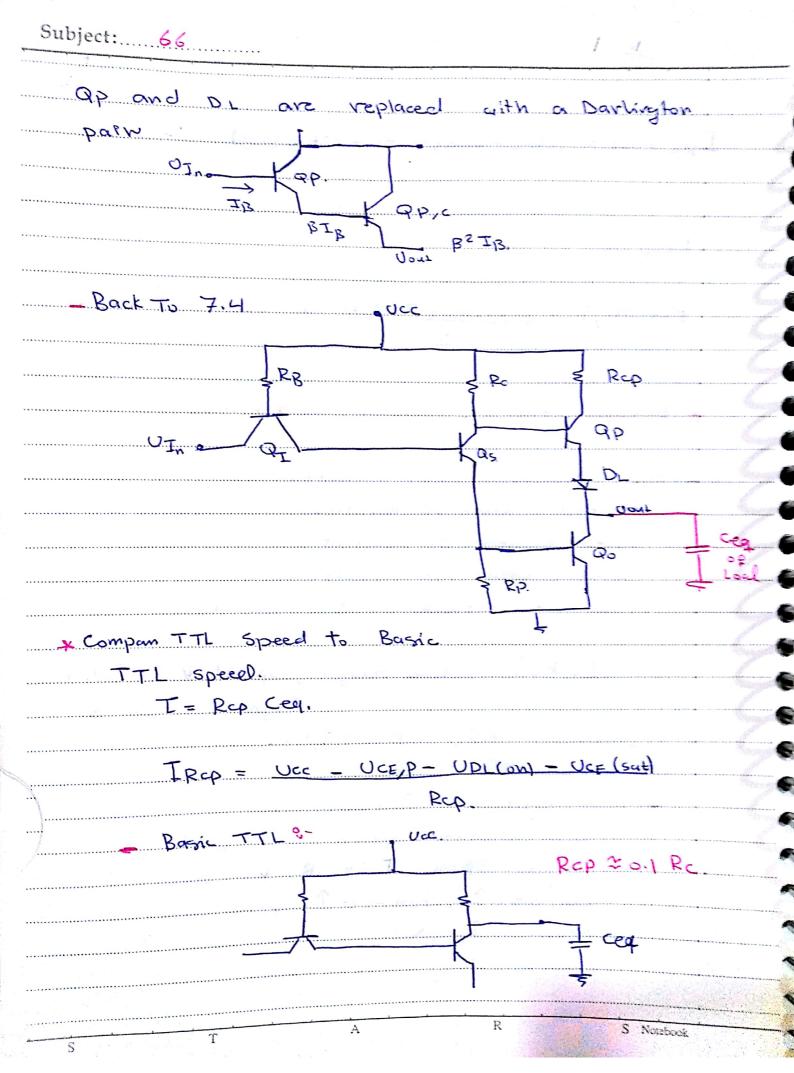
Subject: & 1 1 Ignore TB, p (F.A) = TRC. UOUF = UCC - UBE, P (EA) - UDL (ON) $O_{OH} = 3.6 O$ UTL Supprt at which Qs turns to F.A mode, , workern $UTN = UBE_{15}(F,A) - UCE(sat) = 0.5.$ QS JORP Eoc (for QS, Qo Still off). 3.6 = UOH 2.5 UTL UTB UIN - As Input increases, Qs draws more current. Ubut = Ucc - IRC Rc - UBE P (FA) - UDL (ON) >dec Increases UTB > input Break points - Eac for Qa UIB = 2UBE(F,A) - UCE(sat) = 1.2.at which Qo turns to F.A mode. when Qo & Qs are both on current through Rc in crease even more. -Uput drops fastor , UTC curve is steeper S Notebook R 5 T

Subject:.....62 1 1 ✓ UbB → output Break point. UOB = UCC TRC RC - UBE, P - UDL (on). 1 gabre IB, p (F.A), IB, s (F.A) TB, o (Eac), also ingore IRC ≈ IC,S ≈ IE,S ≈ IRD = URE, (FA) RD. UOB = Ucc - UBE, (F.A) RC - UBE, p (F.A) - UDL (ON) ~ 2.5. * UTH 3- Qs Op Saturate UTH = 2UBE(sat) - UCE, (sal) = 1.4. $UoL = UCE_{v}(sat) = 0.2$ * 7.6 Fan - out RC 2 PR. A P Q5 541 ToL asoff Jon F RA Qour Rp . R S Notebook T S

1 1 Subject: 63. Fan out analysis performed at Driver output Low, for QT to operate in sat mode. TF QT opreate in R.A (high input at Load) $T_{TN}' = TE, T (R, A)$ $N = \frac{1}{1}$ TIL = IP& = Ucc - URE (sat) -UCE, I (sat) RB. TOL = TCO = OBF TBO. TB, 0 = IE, S - IRD $\frac{1}{RD} = \frac{(BE, o(sat))}{RD}$ TE, S = TB, S + TC/S. TC,S = TRC = UCC - UCE,S (Satt) - UBE,O (Satt) \overline{TB} , $S = \overline{TC}$, $\overline{T} = (1 + BR) \overline{TB}$, \overline{T} IRB = IB, I - Ucc - UBC, I (R.A) - 2UBF (set) RB. S Notebook R S T A

Subject: 64 8/3/2018. 7.7 TTL power Dissipation :-• NCC = 5 V PB Rc. Re QD FA OPE QI n /off UIn. sat Sat out H Q.s... QooF R.A. RD Jec (OH) !- (with No Load) UCE (sat) IRB (OH) = UCC - UBE, I (Sat) - UIX (LOW) UIN (LOW). RR $I_{R_c}(oH) = I_{B_p}(F,A) = 20$ IRCP(OH) = 0. with Load TED = TE, I (R.A). (U.Samil) * Icc (01) 8-TRBColl= Ucc - UBC, I (RA) - 2UBF (sat) RB R A

1 1 -Subject: 65 IRC for) = UCC - UCE (SAT) - URE/o (SAT) RC IREP = 0 Pcc (aug) = Icc (oH) + Icc (oL) & Ucc. 2 * Example 7.4. Per (aug) = 10.4 m Ce 7.9 Low power TTL (LTTL). higher values of Resistors. Lower values of current. Lower values of power. Fan out decreases (dis advantages) I = RcT (Time delay), speed 4 (dis) design use x Example 7.5, P= 919 Mw. 7.10 High speed TTL. Less Resistance values. higher speed I = Rc V. current 1, Fan out 1, V. Power 1 X. S Notebook R T A S



1 1 Subject: 67 I Basic = Rc ceq. $T_{R,c} = U_{CE} - U_{CE} (s_{q}E)$ Rc. TBASIC > TTTL ? => TTL Much Fast TRC < TRCP * Chapter 8 Schottky Transister Transister Logic STTL) SBD VIC Sat Jupze sit x Je Te ISBD $Q \longrightarrow Q_{SBD}$ Τ**Γ** Schottky Diode (SBD) 8-..... = Pis replaced with metal (M). 5B - USB (0N) = 0.3 when Q Saturates, UBG - UBC (Sat). TE an SBD is connected bet ocen base and collector it will divert the input correct and it will turn on to clamp UBC at USBD (onl = 0.3 R T A

11/3/2018. C QSBD. Q E * requiar Q saturates at UBC (sat) - D.GU. if SBD is connected between Base and collector. e and courrent is applied SBD will turn on and direct awarent from Q, preventing Q Rorm -Sat wration UBC = USBD < UBC (sat) 6 > operation modes. 8-1. UBE-UE, UBE-UE QSBD off and current Zero (SBD off $Q \circ PP$). 2 FA mode. UBE the UBC - Ve QSBD in F.A mode SBD OFF, Q F.A, UBE (F.A) = 0.7, TC = BIB. TE = TR + TC3. Hard mode. UBC TUE, UBE TUE. SBD on Q on UBC (nard) = USBD = 0.3. NBE (sharted) = 0.5 = UBE (hard) - USBD = Georgian while not enclose the second of the R S Notebook A

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	(B	- c) Ţ	Jan Sapa	M.A.I.				
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Fen	UI nple 8	.]		para ré francé	s).		<u>усс.</u> ЧК	
Frn Uout. DOH	UI nple 8	.] ре. <u>L</u> е		para ré francé	s). RB		ЧК	Usut
Uout.	UI nple 8	.] ре. <u>L</u> е	egric swi	ng. (1	5). Rr		ЧК	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
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(0 / 1 0 0 $U_{OH} = U_{CC} = 5$ UOL = UCE (hard) = 0.5. 0 LS = 5-0.5 = 4.5. 0 $U_{JL} = UBE(F,A) = 0.7$ 0 ٨..... -UTH - TBRB + UBE (hard) 6 t de la company de - $I_B = \overline{I_C}$ --× 8.3 Schottky - clamped TTL (STTL) UCC -Contra to Rcp. RC RBJ -FALOP QP2 Eoc Off F.AJ Contraction of the second Qs OINO REP hard Nout. 6-Ris Ward -Qo UBIO 072 -RBD RcD 0.7 have 6 QD F + UBE (on F 290 hard R. A. B. CU APP, QP2 8- pri Darlington par provide high 6 current. ---S Notebook R A T S. F

1 1 -7 * RBD / RCD are Designed such that as and 1 go two on Simultaneously also, Qo, RBD, RD are conduction path for Qs to ground. if QD is off, as will be off too. Qs- will true only when Qo, QD cire on. > No Break point and transition width is Natrower than in regular TTL. QD, RBD, RCD discharge path For Do. > high speed. STTL T = 2nsregular TTL T= lons. $Qp \rightarrow + Ucep + UBE, p_2 - Uce, p_2 = 0$ UCE, P2 = UCE, P + UBE, P2 > UCE (sat). does not saturate => no need for QSBD. REP! Discharge path For 9p2 * RBD > RCD, IBD ignoured when Oo is on. p S Notebook A

Subject:	7.2			/	1	
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	and a second					
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	OTL	NIH		JT IV		
	- inpre	I Low	Qs , Qa	s off	-	
and the construction of the second						
		10, 43 o	FF ,	9p, 9	2P2 F. /	4
a da da an		*				1. X
an a	and a second	$R_{c} = T$	BP (F.A) %0		* .
ويعتر محدور والمحاف والمراجعة والمحافظ المحاوم ألمانه						
		$U_0H = 0$	Jcc -	20B(F.)	A1 = 3.6	\$
والمراجع والمراجع والمراجع المراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع						
	*****	URC	> VRCP	-> UB	c, p - Ue	· · · · · · · · · · · · · · · · · · ·
		P2	also F	Α.		L
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anani da farana, tarafai a tarafa matan ang kabag	* Input	high.	951	Qo Har	d Ur	3p = 1.30
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						S Notebook
		UIL Tropre Vot I I I I I I I I I I I I I I I I I I I	$UI_{L} UIH$ $Input Low$ $VI_{VOH} Low$ $VOH = UIN$ QO_{VO} $IR_{C} = I$ $UOH = I$ UR_{C} QO_{C}	$ \begin{array}{c} $	$\nabla T_{L} = \nabla T_{R}$ $-Triput Low, Q_{S}, Q_{0} = off$ $+ \nabla O_{M} \rightarrow \nabla T_{N} < 2 \cup BE(F, A) = 0$ $Q_{0}, Q_{3} = off = 0$ $T_{R} = T_{BP}(F, A) \approx 0$ $UoH = Ucc - 2 \cup B(F, A)$ $UoH = Ucc - 2 \cup B(F, A)$ $CRc > V_{Rcp} \Rightarrow UB$ $Q_{P} = ofs = 0$ $Q_{P} = off = 0$ $Q_{P} = off = 0$ $VTL = uhen Q_{0}, Q_{S}$ $VTL = 2 \cup BE(F, A)$	$VI_{L} VIH$ $Tripit Low. Os, Qo off.$ $VOH \rightarrow UIN < 2 UBE (F.A) - UCE (ho Qo, Qs off. QP, QP, F.A. IR_{C} = IBP(F.A) \approx 0 UoH = UCC - 2 UB(F.A) = 3.6 URC \geq VRCP \Rightarrow UBC, P - UE P_{2} also F.A. Tupit high. QS, Qo Herd UT Enough to turn QP to F.A. QP_{2} off. UIL When Qo, Qs turn F. UIL = 2.UBE(F.A) - UC$

6 Subject: 7.9 1 1 9 -UTH! Qo, Qs turn hard. -UTH = 2 UBE (hard) - UCE, I (hard) - $= 1.1 \cup$ -6, ¥ UOL - UCE, a (hard) = 0.5 U -+18 5 G 1 6 6 HNH = 3.6 - 1.1 = 2.5...... -LNM = 0.9 - 0.5 = 0.4.13 * 8.4 Fan - out UCC Rc F.A Rep. RB. QP F.A TIL RB 6 QP2 REO . @.s.... hard NIU OFF R.S JoH C.UD.4t .L.... hand H H Q T JC/ 90 Reput RBD off hard Q'P A 620 N-Load gate. har R A S Notebook T 5

Subject: 75 1 1 ř are performed when Driver 0/p is Low so that Qf is bard and current Plows. N= IoL IT, TIL = Ucc - UBE, I (novel) - Ucero (novel) R RB $T_{OL} = T_{CO} = \beta_F T_{BO}$ IBO - IES - ICD. TCD = UBE, o (Hard) - UCE, D (hard) -Rep IES = ICS + IBS (igonre IBp(FA) Ics & IRc = UCC - UCE, S (hard) - UBE, O (hard) Rc. -IBS = ISBD = IRB = Ucc - UBC (R,S) - 2 UBE (have) RB. U BC (RS) = USBD = 0.2 U S Notebook T A R

Subject: 76. 5 1 ICS 5--* Example 8.3 (Fan-out). 1 N = 149.2 = 149.--..... -8.5 × power Dissipation 1---1. Icc (oH) = TRB (OH) + TRC (OH) + TRCP (OH) ST. -..... TRB (OH) = UCC - UBE, I (hand) - UIN (Low) -----R.B. F IRC (OH) = IBP (FA) Ignore 20. ... F TRCP(OH) = TE, P (OH) = UCC - UBE, P(F.A) REP -Qp2 conidered off (Load or no Lovel F Floatell (TE'S (R.S) = 0) F ... 6 2. Tec (01) = IPB (02) = Ucc - UBC (R.S) - 2 UBE (nord) RB. TRC(OL) = UCC - UCE, S (havel) - UBE, O (have) Rc. R S Notebook T 5

Subject: 77 15 / 3 / 2018. U.S.E, p(r) TECP (OL) = FREP (OL) = UCES (Mard) + URE, o(mont) -PEP-Tec (oL) = TRep (OL) + TRE(OL) + TRE(OL) + Paug r Icc (oL) + Icc (oH) & Ucc. 2 Example 8.4 => Pec (aug) = 20.05 mW. 8.6 LOW POWER STTL (LSTTL). 1.0 pr VTC, Fan out, power Dissipation. * Notebook

1 1 Chapter 19 Emitter coupled Logic (Ech). 1 11.1 BJT current Switch. -0 1 Julia louce 0 RCR ę RCI UNOT = UINU -UBB QR UIn_ QI 01+age 7 6:459). UF (current source is in the late is a RE -UEE IRE = UE + UEE RE UINU = Ucc - IcTRCT UNTIN = UCC - TCP RCP. UE = UIN - UBE. 07 UE = UBB - UBE, depends on which BJT. 15 on. UBE(F,A) = UBE(EcL) = 0.75 U.A T R S Notebook S

Subject: 79 1 1 if UTN < UBB, QT OFF, QR ON. UINU high, UNINU Low. 2 IF UIN > UBB, QI ON, QR OFF UINU LOW, UNINU high. 11.2 Fol (current switch UTC). vo. 8 Both on but QR conducts more Use= UoH ____, Both the same. Both on but QI conducts more. QR OFF JUIN UINL UINH ليه غترج الانتقابل عن H ال × Consider UINN For O/P Lain a strike se for I- Uott UIN < UBB. - AND QRON UE = UBB - UBE, R (Ecl) UBE, T = UTn - UE= UIN-UBB + UBE, R. LITI UCIS UBE, I < UBE (EcL) = QI OFF. 8 C Natahaal

0 Subject: 80 1 1 Com. - $J_{C_T} = 0.$ -Vout = UOH - UINU = VCC. -..... -× Threshold Uoltage. 6----UTN = UBB, QI, QR, ON 6 6-IRE - UBB - UBE, R (ECL) + UEE = 2IC, T Carto -RE. F UINU- MUCC - TOT ROTS P $I_{c,T} = I_{RE}$ --7 For centain values of resistors, use use ---and the second UTN = Uout = UBB. Design Utime un Lo LE KITCH LE H Contraction of the local division of the loc the second s $\star T.w = 0.1 = UTH - UTL . 1215$ -1 - L UIn L = UBB - 0.05UTNH - UBB + 0.05. P 11114130001344 × UoL > UIN > UBB. QT on $UE = U_{TR} - U_{BE} T (E_{CL}),$ at UIN = UBB + 0.05.--Chan I R S Notebook A AtS

Subject:......\&\ 1 × UBE, R = UBB - UE = UBB - UIN + UBE, I, UBE, R = UBB - UBB - 0.05 + UBE, TUBF, R < UBF (ECL) $\rightarrow QR \ off,$ - TRE = UIN - UBE + UEE - TC, I Re UINU = Ucc - IC, I RG, I. UIN - US, UINU (US) ; when QI Saturats. QR does not saturats Since UBB is fixed. $TRE = (US - UBE_T (sat) + UEE) / RE = TC_T$ UINU (US) = UCC - US - UBE, I (SOL) - UEF RET RE. eqn(1) UINN = US - UBC, I (sat) eqn (2) Solve 14-2 For Us. S T A R S Notebook

Subject:			andra and a second s	1 1	
×	Ns = <u>UC</u>	+ UBC (s	$at) + \frac{R_{CT}}{R_E}$	UBE-(Sat)	- UEE
		Lief Leen de la		<u> </u>	
			3) , 1	1.7.1.2	
			<u> </u>	9 (J	
		I - 174 F		- 1511 -	
			4 54		
				1.1.2.0	•••••
and the la	rei <u>t in I</u> ndu	(<u>479. 20</u>	lad set	
2000	<u>1 cr dans:</u>	enne al cara te	24	21 ⁽ 2	
	z al (az	: 1 + (tos) 5 .1	90' - K ige)	- 1 <u>5 -</u>	
<u>ost 35</u>	<u></u>	0.1 - W		<u>) : : //:35.54/</u>	`
	<u> </u>				
		(<u>†).: 1 6 2 4</u> 1		<u></u>	
			4 C 2	a second	
	·····	A	R	S Not	book

Subject:	ge ben zweiten gestehen zweiten zweiten er stellte beiten der eine stellte beiten gesten gestehen gestehen stel		2/3/2018.	
		RCT T	Uptitsqt) - UE	E
Ns + Ucc +	UBC (sat) -	T RE L	- BC	e
		RE		S
* Example 11. 1				
- II.4 Basic Ec	L, NOR, OR	Gate.	<u>3</u> /	
	J V CC			
UNOR	D-T	Der		C
S.WSR			Sal -	
UTn PTB UTN	QIA .	QR	UBD	
			X Z C' -	(
and the second			lassi.	
4		UEE		
RCI < RCP -	~ ~ ~	V.C. Trav	where Lot in	
and the state of t				
NOW TNV				
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008				•••••••••••••••••••••••••••••••••••••••
Peon , Justine	C. 246	haanna ar		
	> V=	I.M.,		
UTL UBBUTH			364.00	

Subject: 83..... NOR 0.R.m. A B ۱ and have 6 0 6 1 0 hankananananan 0 0 Any input high QI on, QR off (corresponding). UNOR = UCC L TR, I RGI LOW TR,E I later of Standard Standard UOR -> high. + All Inputs Low, 973 OFF UNOR high - UOR -LOW. **Q** * Ad vautages 8-Low Sensitivity to noice, due to differential nature of the ect. ucc always provides cct with const. current. S T A R S Notebook

Subject:.....8.4 d' 11.5 MECL (I) NOR/OR Gute with interior in a ď. output (Buffer) 3-Ċ. RER F.A QBN F.A QR - URB OP1 RDN ess than -0.75 RE کل الارتمام سیالی - UEE Fan-out 1 per ligh speed - Fan-out 1 per li por air inni jadu disadvantage power? dis * QBN, QBO ' Buffers (F,A) 6 - high output current -> high Fam-out. 1 high speed (Pastest). R high power dissipation X * provides level Shifting between current Switch and UNOR and UOR, For input and o/p to be compatible, S Т A R S Notebook

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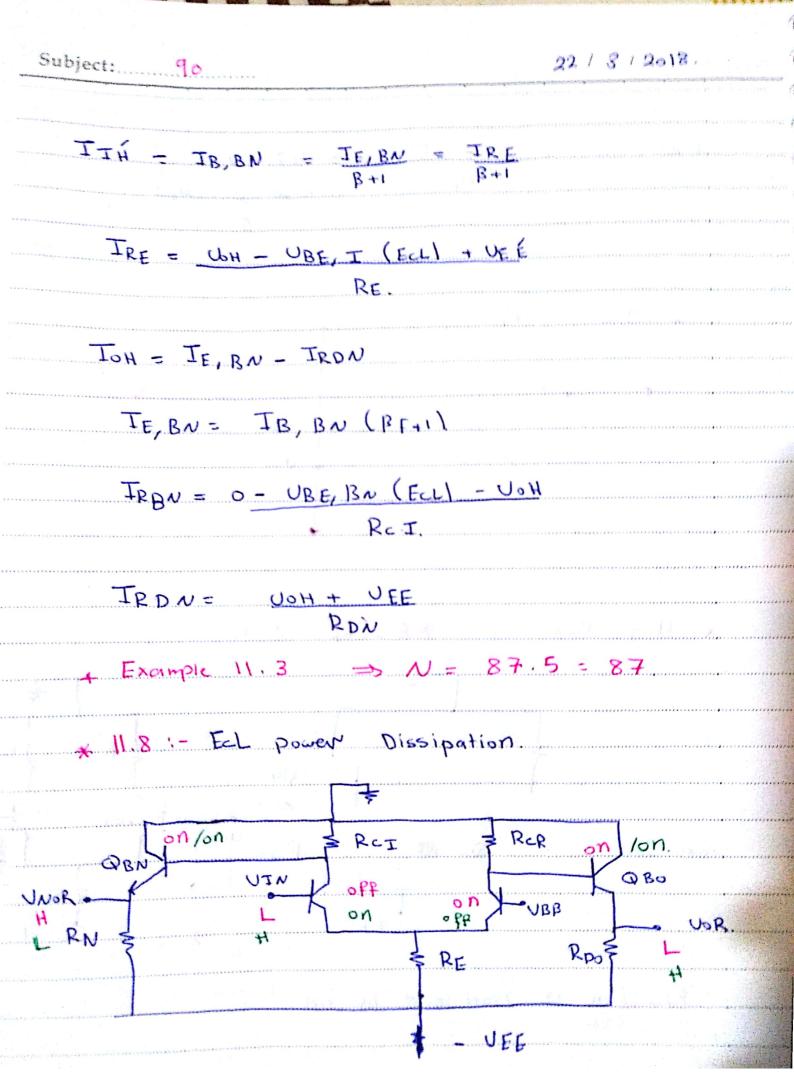
13 20/3/2018. Subject: 8.5 RDN RDO >> Pull - pown * dis ad van tage > high current spikes due to switching capability. * For more than one input RCI < RCP 11.6 MECL UTC. RCI RCR QBO QBN UBB KQI. UGR. NOR \$ RDN S RDO RE UEE-K VoH) input Low QI OPP QR ON (Ecl) VNOR = VOH. = O - TB, BN RC, I - UBE, BN S Т A R S Notebook

Subject:......8.6..... TB, BN RCE + UBE, BN (ECL) + TE, BN RN - UEE = 0 IB, BN (BF+1) TB, BN = UEE - UBE(RCI + RDN (BF+1)) $(2) \rightarrow U_{IL}, U_{H}$ UIL = UBB -0.05 UIH - UBB +0.05. (3) Vol / input high , QT (on) QR (off) 1 8 8 U V V VNOR = UOL (ECL) 1 = 0 - IRCT ROT - UBE, BN 1 IB, BN can be igonered compred to ICI. ale : IRCI ~ ICI ~ IRE - UTA - UBE, T (ECL) + UEE UTH D-1 UIN = UBB + 0.05 4 8 94 -S T А R S Notebook

1 NEG is cail so Vec up 7 and sing is in the H & VC VIL 11017 NNOR (VS) Vs and VNOR (Vs) when. QI saturates $\left(\frac{+ \text{US} - \text{VBE, T}(\text{sat})}{\text{RE}}\right)$ + UEE RCT - UBE, BN (ECI VNOR = -VNOR = US _ UBC, I (Sat) - UBE, BN (ECL) Us = UBC (sqt) + RET UBE (sqt) - UEE RCT RE S Т A S Notebook R

1bject:	1 1
* Noise Sensitivity and Imm	zunity.
	·····
- Noise Sensitivity 3- quant	ifics input uariations.
that affects output.	
HNS = UOH - Um	7
LNS - Vm - UoL.	•
* Immunity := ability to	reject noise HNJ = HNO
	Ls
HNI = UOH - Um	
	00 V. 1 (
LNI - LNS = Vm	- USL G
- Example 11.2 UBB = -1.	
Immunity, Logic swing, r	loise margine.
$U_0H = -0.76$, $U_TL =$	
$U_{0}L = -1.55$ Us =	
UNOR = -1.640,	
and the second	
LS = -0.76 + 1.55 =	
LS = -0.76 + 1.55 = $HNm = -0.76 + 1.12$	25 = 0.365
L S = -0.76 + 1.55 = $H N m = -0.76 + 1.12$ $L N m = -1.225 + 1.4$	25 = 0.365 95 = 0.325
L S = -0.76 + 1.55 =	25 = 0.365 95 = 0.325

1 1 Subject: 89 NI - -1.175 + 1.55 - 0,475 U. P لى لائم تكونم قلوبة ها 0.5. TC (OR) HED Hall USL * 11.7 Fan -out MECL(I) NOR RET RET - QBN NOR an UOH U RDA input Low QT off -----\$ RE JEE N=IoH => Load must be on. IIH S Notebook 5 T R A



Subject: 91 1 * IEE (ot) input Low &-I) TRE (OH) = UBB - UBE, R + UEERE. 2) IRDN (OH) = NOH + VEE RDN 3) IRDO = (OH) = UOL + UEE RDO. IEE = E Current (oH). TEE (oll, input high "-UoH. TRE (OL) = DIN - UBE, T + VEE RE TRD(OL) = OOL + CEE (NOR)RDN. IRDO (OL) = UOH + VEE (OR) · RDo × Example '- Paug = IFE (oH) + JEE (oL) = 35.6 m.W. 2 S Notebook R T S A

Subject:			/ /	
* Chapter 16 - Meta NosFE	L oxide. T.	Semicanch	Itor (FET) (
N-Mos PMos	6			
D $B_{a} \partial y$ $C -$	-1157		نقب انتجاه . با دما لیتن .	
ی اللہ اللہ میں میں میں میں اللہ میں اللہ میں اللہ میں		Tat	Zero.	
		3		.D
* P- Mos 3- D			cd[C Mos.
C - [= =	n . 125	15	<u></u>	.
		•		
	17 19 ≥ R / NMO			
	* Ent	a mement	- VTN	+ Ve
				1.1. 1.1.1

Subject: 93 * 16.3. Mos FET operation Modes (NMos) * Cut off ~ UCS < UTN, NMOS OF. TD =0. · linear mode. VGS > UTN, VDS < UDS (sat). UDS (sat) = VGS - UTN. TO (UN) = KN [(UGS - UTN) UDS - UDS²] TD UPS (sat) Linear Sat Vas (2) Pricease 1 Vasi (1) , Vos 0.5 1. 5. 2.5 NDS(Sat) - UGS - UTN * Sat Mode., Vas > VTN $\frac{1}{2} \int \left(\frac{1}{2} \left(\frac{1}{2} - \frac{1}{2} \right)^2 \right)^2$

0 Subject: 94 -UDS > VDS(sat)+ 15.4 Mosfet Transconductance 8kn = Mn Cox W width and length of gate $k_p = M_p c_{\delta x} \frac{u}{2}$ Ko' Mo-mobility of electrons or holds Cox'2 - capacitance of oxide Layer per unit area Cox = Eox, Eox permitlivity of axide tox tox - thickness of oxide $\frac{1}{k} k = k \frac{w}{k}, \quad k = k \frac{w}{k},$

Subject: 95 1 1 2) VSG > - UTP USD < USD (sat) linear. $V_{SD}(sat) = U_{SC} + V_{TP}$ $T_{D,p} = k_p \left[\left(V_{S,G} + U_{T,p} \right) \right] U_{S,D} - \frac{U_{S,D}^2}{2} \right]$ 3) USG $> - V_{TP}$ USD > USD (sqt) $Ipp = \frac{kp}{2} \left(VSG + UTp \right)^2$ * Chapter 17 3- Introduction to Mos Digital cct. General N Hos Inverter Job G IL D J JD Ta=o: UIN = UGS Uout = UDS.

Subject: 96 1 1 - Vout - UDD - ID RL 17.2 Zero-Drain Current. Mosfet 3-ID UDS (sat) UG: = 5 VDs (sat) >0 VES> VTN ___ Linear on. $T_{b} \rightarrow 0$ VDS_, o, but in active mode. * Mathematically 8-Vas high ____ Action mode $- ID = Kn \left[(VGS - VTN) \right] VDS - VDS^{2} = 0$ VDS = 2(VGS - UTN) > UDSVDS UDS > UDS (sat). 2 UDS (sat) > UDS (sat) R A S Notebook T

Subject: 97 1 1 Example 17.1 Find Resistance of D-5 channel Ro VGS=5, VT=1, $K=40MA/V^2$. UDs = 3TD = Kn [(Vas - UTN) UDS - UDS2 $\frac{d}{d} T_D = R_D s^{-1}$ $\frac{d}{dv_{NS}} = Kn \left(UGS - UTN - UDS \right)$ $\frac{dUDS}{dTD} = \frac{1}{Kn(VGS - UTn - UDS)}$ b) VDS = 0-Ros - 1 = 6.25KA. Hom(5-1) NDS 1, RDS 1, Conductivity V UDS V RDS V N Mos is used as april-down P. Mos is used as a pull - up.

Subject: 98 1 1 * Example 17.2 3- Graphicall Determini $R_L = 10 \text{ K} \cdot \Lambda$, $V_{DD} = 10 \text{ U}$, $U_{TW} = 1$, $K = 2mA / V^2$ ID .1.mA Q. p. sint. UDS (sat) - VG5 = 5. FRE - VGs = 4 Deli G5 = 3 B 9 A 100 2 6 UDD = ID RL + UDS = DCLL Education De Load line UDS = UDD - JORL a + TD = 0, VDS = VDD = 10Vat Uas = 0, $T_D = \frac{V_{DD}}{R_L} = \frac{1}{R_L}$ A, B, C, D, E > Q-point. E, D => linear, C, B, A => Set.

Subject: 99 it (UDS) O. 7 6 5 Sat 4 .S.. E lin Cin 2 JUTN. (VGJ. 2 3 UDS (sat) = UGS - UTN A, B, C i sat, $ID = \frac{kn}{2} (VGS - VTN)^2$. $U \alpha_{5} = 1, 2, 3 - Jolt.$ UDS - UDD - TO R AND THE ADDAL OF USING STATE $C_1 D_2^\circ$ linear. Vas = 4, 5. $= T_D = k_n E(v_{as} - v_{T_n}) - v_{Ds^2}$ and cia cia Rhis LUDS = UDD - ID RL TD, VDS To (mA)to $\rightarrow 10^{-3}$ UDS Vas AFI B ← 2 Sab $\rightarrow q$ >6 S T A R S Notebook

S	du	b	e	t:			ĥ				I	0	6						
					•	•	•	• •	•	٠	1	\mathcal{L}	9	 ٠.	*		• •	 	

* Example 7.4, Find the partial Differential equation for ID when NHOS 15 in linear Mode. UIN yout ID (VGS, UDS) dID (VGS, VDS) - <u>dID</u>, dVGS + <u>dID</u>, dVDS dVGS dVDS $TD = kn \left((VGS - VT) VDS - VDS^2 \right)$ dID - KN UDS dugs <u>JTD</u> = kn (UGS - UTN - UDS) JUDS JID = KN UDS dUGS + KN (VGS - VTN-UDS) dUN 1-= trad * 17.6 Power Dissipation X Static power Dissipation PDD (and) = NDD IDD (OH) + IDD (OL)

1 1 * Dynamic power Dissipation :exicts also in BJT ccts, but ing nored (pdy << Pstatic) For Mos, Pstatic is also Small and Pdyn cavit be ignored, * Polyn : found when output Switches between high and Low. * Mosfet cets have the smallest power Dissipation CMos have the laset power dissipation amongst all Logic cct. PDJN = CL V VDD Ly sportching Free, capacitance for Load PTotal = Pstat + Polyn * Example 17.5, UDD= 5, V=0.5, UHZ, G=10 pF $T_{DD}(aH) = 5\mu$, $T_{DD}(aL) = 12\mu$. Ppyn = 10p X0.5 M X 25 = 125 MW $Pstat = 5U + 12M \times 5 = 262 UW$ PT = 125 + 262 = 387 Mw = 0.387 m W.S T A R S Notebook

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Subject: 102. 1 1 × 17.7 Fan - out. Driver. Load UIN - K - CLiey (Lih in õsen de n^s-- Fan-out 1 Max capacitance allowed at out of driver that can produce an accteptable Saiting Lime. ()_ charging input $H \rightarrow L$, out put $L \rightarrow H$ N lin > off, cap will charge. Ict = IL = CL duout 2) dis charging. PNput L_s H. output H->2 Noff in , cap will dis charging. * Icl - ID - IL = CL d Vout Tcl = cl d yout R S Notebook A

TANK

/ / $\frac{T_{C_{L}}}{t_{z}} = \frac{C_{L}}{v_{t}} \frac{dv_{0}v_{t}}{dt}$ $\int dt = \frac{C_L}{T_{CL}} \int dvout$ $\Delta t = CL \Delta N$. T_{CL} * Example 17.6, Find CL, Max For At = 1Ms (max Switching Eine). Ici change = 50 MA, Ici Dicanory = - 20 MA. $U_0H = 5 V$ $U_0L = 0.5$ CL = Icl <u>At</u> -> Charging. CL = 50 M 14 = 11.1 pF (1) if you pick G_= III pE find at for bth cases. $\Delta t_{ew} = 1.000 \text{ At dis} = 1.000 \text{ PF}(-4.5) = 2.5M$ × ما حققت من ط جلع الحميدي البحيري من ما . S Notebook R

29/3/2018. Subject: 104 × CL = 4.44 DF DE, ch = 4,44 × 4,5 = 0.4115 50 M At, dis = 1 US. باه، ۲۵ الاتل حت أخت عمر ۱۰ ما من ۲۰ ۱۰ مار من : CL = 4.44 pF, is the correct answer, obvious Since PE was obtained from the Smaller Cervicent. * Chapter 19 Staturated Enhancement only Loaded 19.1 and 19.3 operation + VTC. y VDDQout. No UDS K UIN VGS UIN = VGSOUout = VDSO. DL and GL ave connected VASL = VDSL - Car 4 32 S Notebook R A T S.

Subject: 105 VDSL (sat) = VCsL - UTL - UDSL - UTL UDSL > UDSL (sat) > NL always saturating the second s Q UIN LOW No off. UTN < UTO Uas < UTO. row Mark I prest A = UDD - UDSLIDO = Zero. = IDL (sat) = KL VasL VIL Sector Sector UGSL = UTL Uout = UoH = UDD - UTL 1 Jourt Nooff transition VDD - UTL UM. Nolin No(VIH). VIL VM UIH VIN (UOL) (2) VIL can't be for mad at dyout = -1 JUTU due discontinuily UIL = UTO 2) during transition both saturate IDL (sal) = IDo (sat). S S Notebook T A R

 $\frac{k_{L}}{2}\left(\frac{VasL-VTL}{2}-\frac{k_{0}}{2}\left(\frac{VasL-VT}{2}\right)^{2}\right)$ UCISL = UDD - Uout § VGSO = UTN. $U_{but} = -\frac{k_0}{K_L} \quad U_{T_U} + \frac{U_{T_0}}{K_L} + \frac{U_{D_0}}{K_L} - \frac{U_{T_L}}{K_L}$ the bigger 1 to the steeper the UTC curve 3 mid point UIN = Uout = Um. Both Sat either () or (2) $V\mu = VTO \sqrt{\frac{k_0}{KL}} + UDD - VTL$ <u>Ko</u> KL (UOL, at high mput = UDH = UIN (UDH). IDO (Lin) - TOL (sat) $k_{0} \left[\left(VG_{s} - U_{T_{0}} \right) UD_{s} - UD_{s}^{2} - K_{1} \left(UG_{s} - UT_{1} \right)^{2} \right]$ VGS = UTN (UOL) - UDD - UTL. UDSO = UO = UOL. UGSL = UDD - UONT = UDD - UOL S Notebook R A T

1 1 $U_{0L} = -K_L \left(U_{DD} - U_{TL} \right)^2$ 2 KL (UDD - UTL) + 2 KO (UDD - UTL) UIH. at drout = -1 No liv ID, fsat) = IDO (linear) quradratic eq. d IDL (Sat) = d IDO (Linear). --- 3 $T_{DL}(s_{qt}) = \frac{k_L}{2} \left(U_{DD} - U_{0,vt} \right)^2$ TDo _ Ko ((UIN - UTO) Uout - Uout 2 - -- () 3: dToL * duout = dIDo dVIN + dIDo duo unous will will + Mouls cluout = d IDO JUIN JUIN <u>d</u> TDL <u>d</u> TDo <u>d</u> Workt <u>d</u> View d IDO = USO yout dVIN 2 JOL = - KL (UDD - VOLH) AVD. 2 IDO - KO (UIN - UTO - UOUH)

1 . 1 Subject: dvout = ko (VIH-UTO) + KL (UDD-VTL) dvIN 2 ko + KL. from quadratic equation > anothe relation bet ween Uout UIN => UIH = UTO + 2 (UDD-UTL) 1320 + 1 KL + 1 <u>____</u> R S Notebook A T

1/4/2018. Subject: 108 C Ko (UTH-UTO) + KL (UDD-UTL) d vout = duin 2 Ko + KL. from quadratic equation > anothe relation bet ween -Uout UIN => UIH = UTO + 2 (UDD-UTU) V3LO +1 agu -Example + TDo = TDL a hace men Sat UDS (sat). في هو د = 5 Jout UGS= 4 (UTN (UOL) = Uott of previous stage) UIN Upsa Uas= 2 UGS= UTS UDS B A Uart. UOL 1 che fit (I-U Char) · - UDS = 0 · at $T_{DL} = T_{DD} = \frac{KL}{2} \left(U_{GSL} - U_{TC} \right)^2$ VasL = UDSL = UDD - USWI - UDD $T_{DL} = \frac{k_L}{2} \left(V_{DD} - V_{TL} \right)^2$ at A : IDD = 0 = $\frac{k_{L}}{2}(VasL - UTL)^{2}$ VasL = UTL A T R S Notebook S

1 1 Subject: 109 Usut - UDD - UTL (NO 088) UTL = UTO UTC = Cout = UDSO UDS(Sat) UDD-UTL Sat lin. 2.5 UO(UIH UIN IV 2 VI (01) UTH UTO. م بتكوم وا مرحة س B,C UDS (sat) = UGS - UT. * 19.3 power Dissipation. Static IDD (OH) = O', VIN LOW, NO = O, TDO (off) = ID (sat) =0 IDD (OL) = IDL (sat) = IDO (lin) $= \frac{K_{\rm b}}{2} \left(\frac{V\alpha s - VTL}{2} \right)^2 = \frac{K_{\rm b}}{2} \left(\frac{V\alpha s o - VTo}{VDs - VDr} \right)^2$ 4 PDD (ang) = FDD (all YDD POWER US) S T A R S Notebook

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Subject:..... 2 - Dynamic $Pdyn = C_L V U D D^2$. Ptot = Pdyn + Pstatic. * Chapter 23 23.1 CMOS TNUErter. + ODV (pull -40) S Zer pon P-Mos / of UIN 60) D..... + UGS UDS UTN = UGS Vout = UDS. USD = UDD - Ubut. USG = UDD - UIN. p-Mos -> pull up N- Hos = pull - down. R S Notchook S

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Subject: 112 NSOT UOH. Nsat P-slin UO (VIN × 11 كونو((sat(c) بكوند ا بتار أعل tran sition جا بكن. N Lin, Pasab UDD + UTP 5 6FF. UTH IDN(off) = IDD(UN) $o = kp \left[\left(USCI + UTp \right) USD - \frac{USD^2}{2} \right]$ USD = Zero. $USD = 2 \left(US \dot{\alpha} + U_T p \right) > U_T p \left(sat \right) b \dot{b}$ Uout - Uoh - UDD (2) UOL, UIN = UDD.high input. UIN = UDD = UGS > UTN. UDS(Sat) = UDD - UTN > UDS-> linear mode USG = UDD - UIN = O < - UTP PMos > off. Top (off) = Ton (lin) $o = Kn (lugs - UTN lups - UDS^2)$ UDS = 0Т A R S S Notebook

1 der Subject: 113 Uout = UoL = UDS = 0. USC < - UTP UDD - UIN < - UTD UIN > UDD + UTP 3) at Um = UIN = Nont. Both sat. IDP (sat) - IDN (sat) $\frac{kp}{2}\left(\frac{(UDD-Um+UTp)^{2}}{2}-\frac{kn}{2}\left(\frac{Um-UTp}{2}\right)^{2}\right)^{2}$ Um = UDD + UTD + UTN / Kp $\frac{1}{\sqrt{\frac{k_n}{k_p}}}$ (4) at duout = -1, UIL JUTN N - Sat = TDN(Sat) = kn (UTN - UTN)P- Lin = IDP = Kp ((UDD-VIN-HUTP) (UDD-VOU) (Sthere - day) d IDN (UIN) = d IDD (VIN, UNH) STRACE XHED LINGTO S Notebook R A T S

6 (E 1 541 Ċ 6 UTL = 2 Word - UDD + UTP + LM UTN + Kan munson * What from IDN (sat) = IDP (Lin). -N (lin) - Kn ((Uas - UTA) UDS - UDS²) $P(sat) = T_D(sat) - k_P(USG + UT_P)^2$ 9 > UDS = Jout d IDN (Lin) - d IDD (sat). $UTH = UDD + UTP \frac{kn}{kp} (UTN + 2Uout)$ + kn Kp. from quadratic equations find Unit. * for Symmetric UTC. -> gate. kn = kp $H_n cox (w) = \mu p cox p(w) p$ $5.80 \left(\frac{\omega}{L}\right)_{N} = 230 \left(\frac{\omega p}{L_0}\right)$ $\frac{wp}{Lp} = 2.5 \frac{wN}{LN}$ NEW CONTRACTOR R А T S

P) 5/4/2018 Subject: 115 M- UTL = UTH - U JDD /2 3 -Um ï HNU = UO (UTL) - U(UTA NM = UIL - UD (UIH) 23.2 * power Dissipation :-Pstatic = Zero, IDD(OH) = 0., IDD (OL) = 0 N-off P-off. Pdynamic = C V UDD2 Jo A 1 UT UTL (JM UDD + UTP P... Pomar U IN Um UIN UDD + UTF Example re S Notebook S T R A

6 C) 1.21 66666666 * Example 23.3, Design for Symmetry. UDD = 5. $kn' = 40 \mu A / u^2, kp^2 = 16 \mu A / u^2, 0TN =$ $V_{TP} = -1$, $L_N = L_P = 2mM$, $W_A = Y_{\mu}m$ up = ? , check for symmetry [kn = kp Um = UDD 4444 4444 Um - UIL - UIH - Um $\frac{\omega p}{Lp} = 2.5 \quad \omega n$ $w_{p} = 2.5 \neq 4\mu = 10 \mu m$ ¢, () Kp = 1611 × wp = 80 Mm ¢. <u>крз Чон * ЧК - 80 Шт</u> 2К 0 2 C kp = Kn 2 (2) $U_m = 5 + (-1) + 1 \sqrt{\frac{80}{80}} =$ 6 2.5 0 + 1 80 2 = 2.5. $U_m = U_{DD} = \frac{5}{2}$ Guin Case! $(3) U_{IL} = 2 v_{out} + (v_{IL}) - 5 + (-1) + 1 + \frac{g_{0}}{g_{0}}$ 80 (1) George State 5 ATT. $U_{T_{L}} = U_{0}(U_{TL}) - 2.5.$ MIL. S Notebook R A T S

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1 - 511

Tow (sat) = Top (Lin) $\frac{k_{\rm W}}{2}\left(\left(UTN_{\rm L}-UTN\right)\right)^{2}=k_{\rm P}\left(\left(UDD-UTW\right)USD-USD^{2}\right)$ USD = UDD - UDUt USD : UDD - UTL - 2.5. $\frac{kn}{2}\left(\frac{UTL-VTn}{2}-\frac{kp}{(UDD-VTL)}\right)\left(\frac{UDD-VTL-2.5}{(UDD-VTL)}\right)$ $J_{TL} = 2.125 U$ $\rightarrow UTH = \vec{B} - 1 + \frac{80}{80} \left[1 + 2 U_{0} + (U_{TH}) \right]$ $1 + \frac{80}{80}$ Vout - UIH - 2.5. $I_D(4i) = I_{D_P}(sat),$ LA USG = UDD = UINH UGS = UINH UDS = Uout = UIH - 2.5UTH = 2.875 $(Jm - OT_{1} - OT_{H} - Om$ 2.5 - 2.125 = 2.875-2.5 0.375 = 0.375

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Subject:	/ 4/11	1
23.9 Far t (
23.9 Fan-out (capacitonce the	t ateas onable delay time).	
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e d 111 J 23.9 Fan-out (corpacitance that areas onable delay time). e l Toput el. Propagation delay. e f 50% => input E. ¥ H Pratond al a 50% ADJut. E. Jamily = tpil EC. C. e. -tpHL = time delay, between input scat increasing from Low to high 50% of max, and output dropping from max to 50% of max. E. S. H S/ SUDA C/ ٢¢ 50% Lugtuo E YIC- TPLH Contra State $\frac{2 (VTN)}{kn (UDD - VTN)^2} + \frac{ln}{kn (UDD}$ 7.5 VOD-2UTN tpHL = UTN 1.5 JDD - 2UTN O.5 UDP $(UDD - UTN)^2$ Kn (UDD - UTN)T A R S Notebook

1 081 Subject:....... $\frac{d}{dp}LH = \frac{-2 \sqrt{p}}{kp(\sqrt{p} + \sqrt{p})^2} + \frac{1}{kp(\sqrt{p} + \sqrt{p})} \int \left(\frac{1.5 \sqrt{p} + 2 \sqrt{p}}{0.5 \sqrt{p}}\right)$ Find CL, and CL T Fan - out IP UTC Symmetric - For a signal capacitance CIN = (Wn LN + Wp Lp) Con ? sad or driv Fax -out F : F = Cl CIN Jec A . $\frac{1}{L_0} = \frac{2.5}{L_N} = \frac{1}{L_N} = \frac{$ CTN = (WN LN + 25 WN LN) GX3.5 un LN cox $\frac{k_{p} - w_{n}}{L_{N}} = \frac{w_{n}}{L_{N}} \frac{\mu_{n}}{\cos \lambda}$ $\frac{CL}{K_{\rm h}} = \frac{E C T_{\rm h}}{\frac{Wn}{L_{\rm h}}} = \frac{E (3.5 Wn L_{\rm h}) C_{\rm h}}{\frac{Wn}{L_{\rm h}}} \frac{Wn}{M_{\rm h}} \frac{M_{\rm h}}{C_{\rm h}} \frac{Wn}{L_{\rm h}}$ 3.5 Wh LN Cox S Notebook T S A R

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Subject: 120 1.011 1 3.5 Lo F coi CL (1) 91 kn Hn Car 3.5 LN2 F \mathcal{U}_n CL Mn kn 3.5 LN2 F= Hn 3.5 4N2 [2UTN (VDD-UTN)2 UDD - UTN 0.5UDD + pieres but a Example 23. 10 (read) 5 T A R S Notebook

der 1 Subject: 121 Final. * Chapter 24 CMos Gate 24.2,3,4 NAND, NOR, AND, OR Gates. × NAND , UDD PB PA 0 - Vout NB. NA. VA B out. <u>A</u>___ 0 1 0 1 - 1 - i with a second in the 0 land the second s 0 (1) Any input Lows Nare SFF, P lin 1.a A Low, B Low (UIN = 0). 2 Ipp (lin) = IDN (OFP) = 0 S Notebook A R S

Subject: 122 Vout = UDD - UDS = UDD (high). - Any input Low A Low, B bigh (or vice vera). N's off, P with Low Input lin. P with high " off. IDPA(Hn) = IDN(off) = 0.USDA=0. dout - UDD - USDA = UDD. (high). Q All inputs high (UIN=5). Né lin, Poff. $T_{DN}(Un) = T_{DP}(oPP) = 0$ $U_{DS} = 0$. $U_{out} = U_{DS} = 0$ (L_{ow}) * Ford Symmetry !-For a single Input Pnuerter wp = 2.5 wn/n For a two input = 2wp = 2.5 wn/Ln. Lp TPD = IDN Cohiliz S Т A R S Notebook

Subject:	123				1 -	0/
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1 314 Subject: 125 For Symmetry $\frac{wp}{Lp} = \begin{pmatrix} 2.5 & wn \\ LN \end{pmatrix} \star 2 \qquad (For \pm wo - input)$ For i-input $\rightarrow wp = i \left[2.5 wn \right]$ Lp LpS T A R

* 24.5 AND-OR - Inverter Logic Function (AoT). NDD PA PB PB PB PB PB $PDU_{c} Vc OD VDU_{c} Vc OD VDU_{c} Vc OD VDU_{c} Vc OD VDU_{c} Vc OD VDVA$ OB $VBEnough 6 to Look at Rull down (or Pull-up) cct MS in Services ANDing.TPS$ in persulat D $Ping(For PMos the opposite)ND_{c} ND_{c} ND is in pairallel with (Ac, NB)BD + CA$	Subject:	Digital	126			1 217 1	
$Fn = \left[\begin{array}{c} PA \\ Pa \\ \hline \\ $		24.5 AN			Logic.	- Function	(A.T).
$U_{c} = V_{c} \qquad OD = V_{D} \qquad ND$ $U_{c} = V_{c} \qquad OD = V_{D} \qquad ND$ $U_{a} = V_{A} \qquad OB = V_{B} \qquad ND$ $Enough \land to look at Rull down (or pull - up)$ $cct \qquad NS \qquad in Series \rightarrow ANDing.$ $= Phis in perallel \Rightarrow oRing$ $(For PMos / the opposite).$ $ND \qquad NB \qquad in Servies \Rightarrow BD$ $Nc \qquad Np \qquad CA$ $No \qquad NB \qquad is in parallel with (Nc \qquad NA)$ $= B.D + CA$ $(Hind for AA)$		Fel L	PA (4		en <u>a 9 e</u> en <u>34 e</u> en <u>34 e</u>	a 9 7 9 1 84 1
$\begin{array}{c c c c c c c c c c c c c c c c c c c $				(-	rd P	3. 74	Pb F
Enough to Look at Rull down (or pull-up) cct N'S in series ANDing. I Pis in perallel => 0. Ring (For PMos / the opposite.). ND, NB in services => BD. NC, Np is in parallel with (Nc, NA) = BD + CA			لية ي تاريب			D-11-11	ND
Enoughe to Look at Rull down (or pull-up) cct. N's in series ANDing. Pp's in perallel => 0 Ring (For PMos, the opposite). N.D., NB in Services => B.D. NC, ND 's C.A. N.D., NB is in parallel with (NC, NA) = B.D. + C.A.	(ANN		NA,	UB	1		
$(F_{or} PM_{os} / the opposite).$ $(F_{or} PM_{os} / the opposite).$ $ND , NB in services \Rightarrow BD$ $NC , ND ;$ $ND , MB is in parallel with (NC, NA)$ $= BD + CA$ $(H = a) (H =$	>	Enoughs cct	to Louk	at Rull	down	(or pull	-401
$N_{D}, N_{B} = \frac{1}{2} N_{B} = \frac{1}{2} N_{C} = \frac{1}{2} B_{D} = \frac{1}{2} N_{C}, N_{D} = \frac{1}{2} C_{A} = \frac{1}{2} C_{A} = \frac{1}{2} C_{A} = \frac{1}{2} C_{A} = \frac{1}{2} D_{C} = \frac{1}{2} C_{A} = \frac{1}{2} D_{C} = \frac{1}{2$	P •	÷.	<u>Ips</u> In	PeralleL		Zing	
$(H+a)(7+a) + a(0+a) + cA = \frac{BD+cA}{Fa}$).	NDJ NC,	NB in NA S	servies	$\rightarrow c$	3.D. A	
S T A P	(S		т <u></u> т ((эт	n paralle	L with	(NC NA	

Subject: 127 JOD • F = BD + CA, F = BD + CA' F. OR. PD, PB => Parallel => B+C | PA, Pc => Parallel => A+C PAPE service in PD, PB- (B+c) (A+c) F = (B+c)(A+c)Sec. 1 * Draw Z = (A + B + c) (DE + F)Contra Contra E N:- NA, NB, NC in Parallel. IND, NE -> in Series (ND, NE) - Pn parallel with F (ND, NE), NE in Series with (NA, NB, NC), -Contraction of the local division of the loc PD PC PE PB PE PA 9 NF NE UL 0 UF 0 JD ND NAT NBUE NO U_-AB + c)D + (E + F)(C + H)42 A S R S Notebook

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Subject: 12.8	1 1	
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* Hultici brators (Nea	men) ch15	×.
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2. Mono Stables Has	one stable state and moves t	9
3. Bistine. the other	J state (quasi-Stable) when	1
	ns in the quast-stable state For a predetermined time.	
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Provide the second sec second second sec	ODP	
trigger = vi	C F R F	•••••
	II U3 L Crz D	<u>4</u> .3
No.		
$\textcircled{1} \pm < \pm 0$		•••••
_	, Uz at Logic High cy high	
UY (out) Low,	Ja still hich	Jr .1.
wit Low (stable 5)	tate)	
S T A		•••••

Subje	ct:	129	 				

2-t-z+z+
2-to <t <="" t,<br="">Apply trigger at (at to) , V2 Low, UC=0.</t>
US=0, U4 high, but put genasi)
But capacitor starts charging through R
UL and UZ Increases watched keeps inc until
Us - UTh Considered high input at G2)
and uz back to high also Uz at
5-1-1-5 S
U2 H
U3 H U+h
O3 H Uth
CY L quasi Stable
T P D
$T = \frac{t_2}{1 + 2}$
$+ T = C[R + R_{on}]$
La Resistance of gates and very.
$T = t_2 - t_1 = c \left(\frac{R}{R} + \frac{R}{R} \right) \ln \left(\frac{R}{R} + \frac{U}{R} \right)$
R+Ron UDD UDD-Utw
S T
A R S Notebook

Subject: 130 1 1. if R >> Ron, UTN = 1 UDD $T = R c \ln 2 = 0.7 R c$ $U_{c} = U_{i} + (U_{t} - U_{i})(1 - e^{-E/R_{c}})$ Putn = D Lytarget voltage upp * Two types of mono stable Response 8-() Retriggable (D) no retriggable * Retriggable 8- responds to any trigger applied even if in quasistable State. * No retriggable 3- does not respond to a new trigger. 9f in quasistable state. (1) output (2)S Notebook R A Т S

Subject: 181 -3 555 Tc timex 8-Hono stable Hultiri braton. QCC. R = 5kUn - Jout. R \mathcal{O} nu Regulation 02 record Re Thres hold Discharge. Gert Ger UCC R-----nreshold. -5.55 I Q output C لتحن trigger > Stable State. -> Logic $\bigcirc t < to output Low (Q=0, \overline{Q}=1)$ Ton discharge CT -> UC=0 S T A R S Notebook

1 11 Subject: 132 2) Trigger is applied at t= t1 Tri < Ucc , out of Coz is high (s=1), Q=1, $\overline{Q}=0.(T_1=OPP)$. Vout = high (quasi-stable) T, > OPP (capacitor charges through RT Supremanys Harry 3 cap charges until UE = 2 occ = Uth => Col is on and Reset Flip Flop. Q=0 (out put back to stable state) Q=1 (Ti, on, cop dis charges again) 1 (2/3) ucc UG quasistable stuble Stable. S T A R Notebool

1511

					·····
ex+ C	lcc = 5, 0	tn - 2 +5 =	3.33.0		9.5
<u> </u>	c = 0F +	(u; + dr)	3.33.U e-tIRC.	1.44	
				5 (
3.3	= 5 +	$(0-5)e^{-1}$	Ep/RTCT		·····
·····	t p -	1.1 R = C	τ	2	.
<u></u>		a liei a her			•••••••••••••••••••••••••••••••••••••••
× E	xample 8- Fr	nd min and	lmaxium	induse of	
	R-T IP	Jun 350n	< IT TIC	m A	
·····		P. 1 842	NAMES AND ADDRESS OF ADDRESS OF		
	I Tmax =	URTMAX	_ 5-0	= 10m	
		Rpmin	$= \frac{5-0}{R_{Tmin}}$		3
		4	lists and see	end in	
	RTmir	$1 = 5\infty$ \mathcal{I}		,	
	fundan kali salah dari ku	. i Arcui			
	R-ma;	- URT min	5 - 350	3.3 - F	
		IT m	n <u>3</u> 50	n	<u>Ч. J. L.</u>
			< 5.M.	_	
					<u></u>
		the state of the	UNDER FRICE UF		
		Erg Burn		0,307_	
		<u></u>			
					and the second second
		A		S Note	

Serg e, 1 1 Subject:..... * Digital to analog converter R/2R Ladden Conu. R V.RU, RUZ R U3 28 28 2R. 2R V3 Jz S Uat ! 2R28: 2R Z2R 28 28 Dz Do PI MSB ALS B 4 out. UVEP. 1100 K $D_0 D_1 D_2 D_3$ -For a certain node * if Digital Puput to the left of that node 6 Ps at Logic o (Gral), then said node 6 Sees an equivalent Resistance of 2R, T N: Number of bits .د الا بيتحت قرّ بد R. ... 6 0 0 -S Notebook R A Т S 5

1 1 Subject: $Uout = \frac{UreP}{2} \left(D_{N-1} + \frac{D_{N-2}}{2} + \frac{1}{2N-2} + \frac{D_1}{2N-2} + \frac{D_2}{2N-2} \right).$ $= N = 4 , \frac{D_0 D_1 D_1}{200 11}$ $= Ure \left(\frac{D_3}{2^0} + \frac{D_2}{21} + \frac{D_1}{2^2} + \frac{D_0}{23} \right)$ 1 horis a D3 ilis ing if digital input is given in decimal. vont = n vref (jie). . Example. Find with for inputs with each 0 bit at Logic 1 one at a time. , Uref = 5. -D3 D2 D1 Do Jout 1 0 0 0. Und = Use (1) = 2.50 0 1 0 0 0 004 = $\frac{1}{2} \left(\frac{1}{2}\right) = 1.25$ $= \frac{UreP}{2} \begin{bmatrix} 1\\ 4 \end{bmatrix} = 0.625$ $=\frac{5}{2}\left[\frac{1}{8}\right]=0312.$ 0 0 1 Contra Martin and and the Martin لدنرم مجمع مرم ري الي حو محمد ، عند المبون ----- $\begin{array}{c}
\text{Uout} = 5 \\
\text{L} \\
\text{L} \\
\text{L} \\
\text{D}_{3} \\
\text{D}_{2} \\
\text{D}_{1} \\
\text{D}_{2} \\
\text{Cl} \\
\text{T} \\
\text{Cl} \\$ マーマー T A S Notebook R

1 Subject: 6 6 The sum of these voltage is 4.681<5, 6 because we have $2^{N} = 2^{4} = 16$ Level, 6 but we only tannot (24-1)=15 Gang Level 5 = 0.315 (). 6 6 Uref = 5 5 0.315. N-> number of Levels 10 Contraction of the second $\frac{5}{12} \times 15 = 4.68 \cdot 0$ 6 - $15 = 16 \times 4.681$ achieve an output DE 50 gnorease. UTEP, Uref = 16 x 5 = 5.33U. In general, for amax output Urop = # of Level X UD Max, 6 # of Cocuts * Resolution: - Least detected increment. 9n. Input coltage that can be masured by. the DE/A convert Res = Uref $2^{N} - 1$ 0 A S Notebook R Т S

/ / Subjecti..... accuracy = Res urep 2^N-1 * Example, ' Design a G-bit. R/2R Ladder DA. $9f R_{\rm F} = R.$ 1- Find the analog output to (10 10 10) $(101010) \Longrightarrow (42)_{0}$ $U_{out} = \frac{N}{2^N} U_{rep} = \frac{42^2 \times 5}{5^2 4} = \frac{42^2}{5^2}$ = 3.28. b- Vout = 2.20, find digitar anout. $N = \frac{\sqrt{2\pi}}{\sqrt{2}} + \frac{2}{\sqrt{2}} = \frac{22}{5} \times 64 = \frac{28}{10}$ $(28)_{10} = 011100$ S Notebook A R

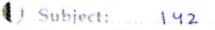
1 1 Subject: * Analog to Digital Converter. Binary-Encoded A/D conu Ri vref de v1) Ri * Curd 8Urar دو جزري تتسارى 9 R المقارمات ، فكن جوز R Zurer. 9 a R' = R1 bares - 27 Q2 Dy 8x3. QI 5urel UIN D3 Encoder Qo DZ 6 4. Vice DI -Do C 3Urel ZUGP 2 Uref Col 9 z Pi 9 9 UTN > UYCH, UTN < 2018 5 only Col has highoutput rest Low o/p. 3 2 2 R S Notebook A Т 2 S

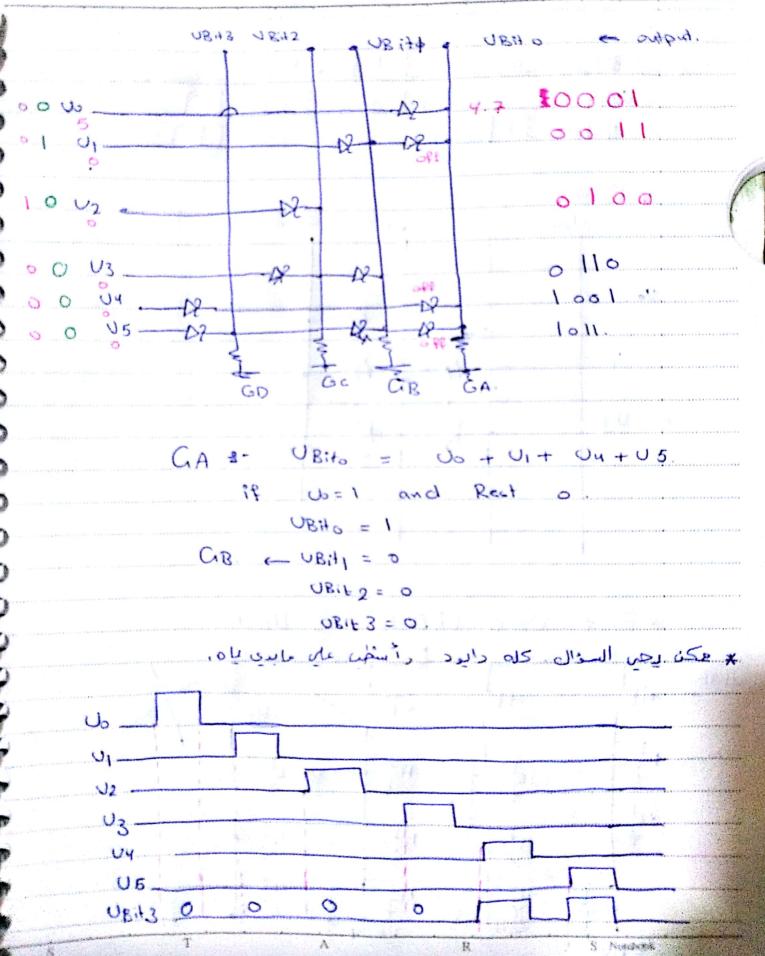
Subject:..... 000 0000 1 IF UIN > 20ref UIN < 3Uref 9 0000 0011 + Comparato number = m. Usef m= m Usef N+1 # 08 bit عرد.... 6 B 1 2 out put of Comp Q2Q1Q0 D7 D6 D5 D4 D3 D2 D1 D0 000 \$ 000 0 0 0 0 0 0 0 0 0 0 1 1 0 1 0 0 1 1 1 1 0001111 100 0.001 101 1 1 1 110 111 R S Notabo

Subject: $e^{-} = \frac{2 \sqrt{2}}{2} = \frac{3}{2}$ $UT_{N}=2.5$ high to on the cop cop 11 0000 out put olo, $\neq Q_{2} = D_{1} + D_{3} + D_{5} + D_{7}$ 21 131 $Q_1 = D_2 + D_3 + D_6 + D_7$ $Q_2 = DY + D5 + D6 + D7$ Fx! - m = 5Q0 = 0 (D5 + D7 or Bit Lobr $Q_1 = 0$ $Q_2 = 1$ $\Rightarrow 100.$ * Res = Uses Acc = Res urep = Examples- find the range of analog a) inputs that correspon to binany Number (000 11 111) Uin, min > Urer 5 = 5 Urer = 2.78. Vin, mux 2 Uref, 6 = 6 uref = 3.33 U. Α R T S Notebook S

Subject:..... () Find the residution = 5 = 0.56 U astr c) find binary o/p if UIN = 1U. VIN = 10 > m VrefN+1UIN-1 < Uref (m+1). $\frac{UIN-1}{m5} \rightarrow m < 1.8$ 1 < (m+1) = 5 > 0.8.i'm=1 => only o/p at Col at. is high, others are Low. 100000001 Encoded ofp => 000 * Chapter 32.1, 32.2 Diode and BJT (Read-only memory) Rom (oR Gates)

6 Subject:	UBit	3 18:12		JB (the	UBi	۰. ح	orgbry,
				<u>2</u>	<i>u</i> 7	1000	
			-12-	DZ- SFI		001	1
						010	.0
				-29P			
7 0 V5-	D7		- AZ-	S Stt			
<u>a</u>		GD (Зc	Ĉβ	ĞA.		
	Ga 🔹	- UB;	to =	= Uc	s + U1	+ 04+	U <u>5</u> .
		if Uo	= 1	and			U <u>5</u>
	, 	if uo UBit	= 1	and	Rest		U <u>5</u> .
	CB.	if Uo UBit CBit	= \ o= \ t_i =	<u>and</u> 1	Rest	<u>o</u>	
	CB.	if Uo UBH UBi UB	= 1 0 = 1 1 = 1 1 = 1	and 0	Rest	<u>o</u>	U <u>5</u> .
	C.B.	if Uo UBH UBi UB	= 1 0 = 1 1 = 1 1 = 1	and 0	Rest	<u>o</u>	
	C.B.	if Uo UBH UBi UB	= 1 0 = 1 1 = 1 1 = 1	and 0	Rest	<u>o</u>	
	C.B.	if Uo UBH UBi UB	= 1 0 = 1 1 = 1 1 = 1	and 0	Rest	<u>o</u>	
	C.B.	if Uo UBH UBi UB	= 1 0 = 1 1 = 1 1 = 1	and 0	Rest	<u>o</u>	
	C.B.	if Uo UBH UBi UB	= 1 0 = 1 1 = 1 1 = 1	and 0	Rest	<u>o</u>	
	C.B.	if Uo UBH UBi UB	= 1 0 = 1 1 = 1 1 = 1	and 0	Rest	<u>o</u>	
	C.B.	if Uo UBH UBi UB	= 1 0 = 1 1 = 1 1 = 1	and 0	Rest	<u>o</u>	

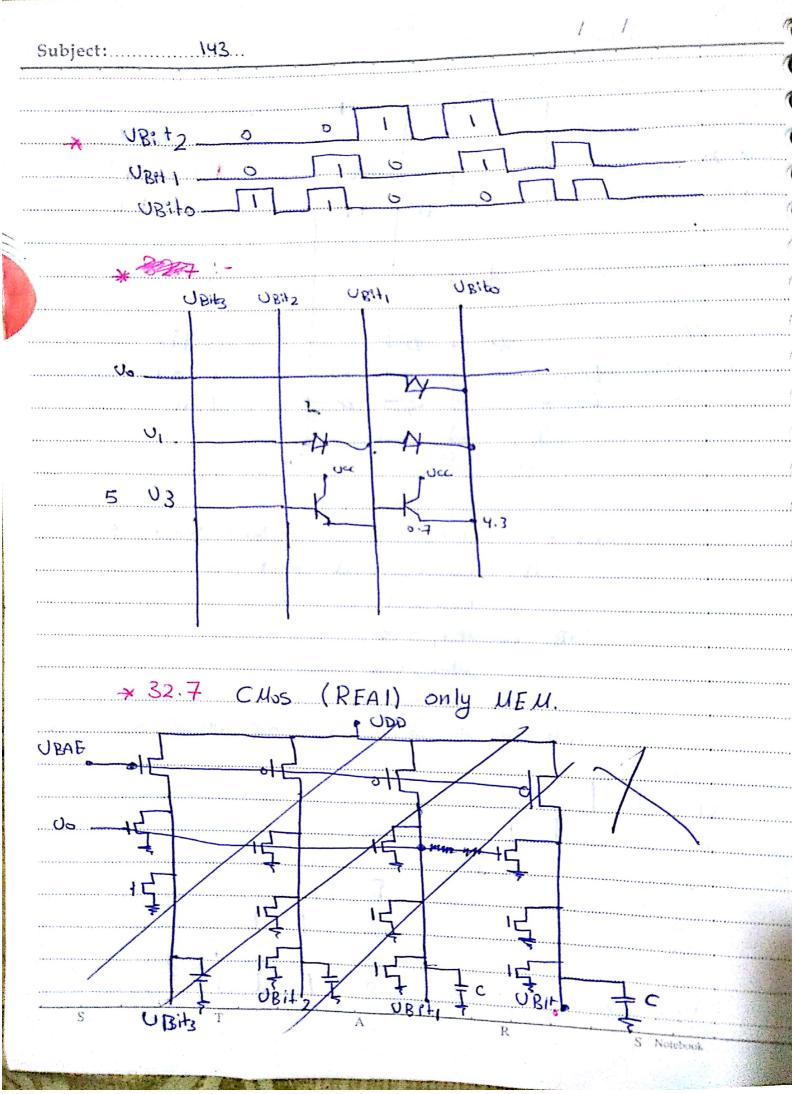




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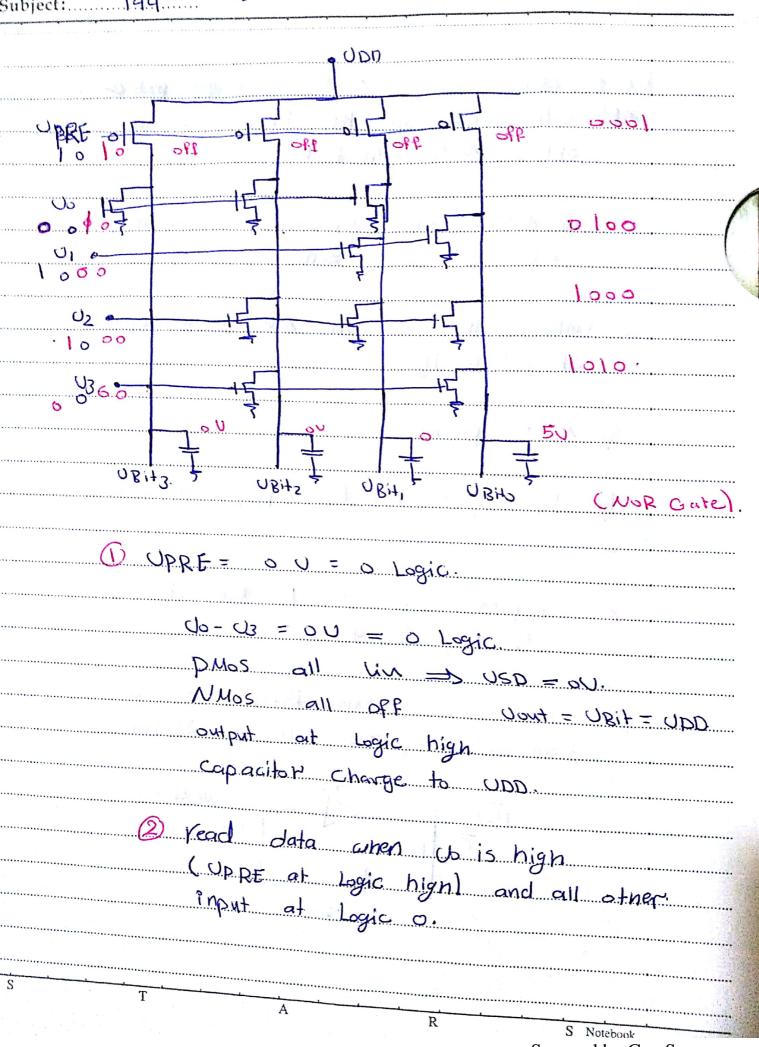
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Cher Stat State State

1 1



1.1 Subject: 145 PHOS OFF. all NMOS except guilton set the ones an the first line are all off Nulos In Fist are all on! 3.1 on NMOS will dis charge capacitor to ou => Logic Zero. Gates with no on Nulos will remain. at output high. I - the set is a set of the 3) Next preset 4) Uppen (and Uppe) Rest Zeros. * Chapter 33.1 - S2 Random Access Memory RAM 33.1 and 33.2 Static RAM (all with trans mission gotes Mos FET SRAM Ŧı Лен Hen Q 0 \mathcal{Q} I2 S Т R S Notebook

1 11 Subject: 146 * RAM ! pata can be read in asequence In dependent of the order Pt was or iginally writter SRAM :- Maintains Storag, of data as Long as power is applied to semicondutor cct . F5 1.64 Buline. NTI NEM. HEM RL * NT1 4 NT2, Trans mission Crate, when we high NT are on and conduct when WL Low NT's off and don't conduct (Store) on -> (Read 4 write) off _____ (store) vije T S Notebook S R A

.

1 Subject: 144 1_ Store wit = 0. NTS opp date in cell Ventus the same MEM = 1 Con-2 write _ when NTS on 6 M = M = BL, M = BL3- read wL=1, NT's on BL read Memory , BL = MEM BL 5 MEM -Garren - Example 3-BL H 14 e BI W write 1 hold hold MEM write.o. C 0 S T A R S Notebook

los 1 UDD. BL BI 990 u'n Pol Po2 ON MEM NT_2 on NT, THEN 11 off NOI OPP 1in No2 0 MOS Static KA Cell 0.6 Schwitt trigger. UIN UFD 1 Low Erippoint VIU Gul high S T S Notebook A R

Subj	ect:	*****	149	

1 1

I- Initially supert is considered Low, and o/p 9s high When UIN = UID, Out goes drown and remains So unITL UIN = UINI 2 - When UIN = UIN, Usut goes up and remails so mitil UIN = UID Difference bet ween UTD and UTU PS called (hystersis) ST removes noise or referran Signal UTO Usut. C C F UIN UIU UID C C D Δ

Subject: 1.50 1 * Initial o/p high O und UTD, Us I tage Low 2 remains Low unit, PAPUT goes to UIN => out put goes up K Emitter Coupled Schmitter Trigger. , Uce non-Inverting Rcs2 Resi JII J26 Louis Louis UINS -Qs1 Q52 F RE Unt Non- Inverting ST Voh 1 VOL UIN. UIUS. JIDS S Notebook A R T S

Subject: 151 1 1 1) - Uales Carrier $VoL = Oce_2 (cat) + OE$ Case In UBC(sq2) VCC - UCE(sat) VCG . UE = Resi Resz Contraction of the local division of the loc RCSI Resz RE and he See I End 0 2) - UTNS - UTUS - UBE, S (F.A) + UE. 0 3) - OoHS - Ucc $(1)UID_{S} \rightarrow UID_{S} = Ucc + \left(\frac{Rcs}{R_{E}} + 1\right)$ 0 UBE, (soch - UBE, 152 (FA) Resit RE 57 * Figure 10.10 SNAND ... Noice co wel Vce Fuput of ST Inp 4+ ON K ST 01p 02 90 Level 'STU NAND NAND ON L "Stricf Hing non-inu HIUID INPUT Stapp H! UILT Logicinderin H Hout-put of ST 0 6 e e S T A E R S Notebook

Subject: 152			/	1		
+UTC of SUANDE						
* UTC OF SNAND & * UTU = UID - UD (on).						
UID = UIUS - UD						
χ $O_{2H} = O_{CC} - O_{BE}$						
VOL = UCE (Sat)						
						3
1 Vout						
UoH.						
Vol					••••	
		UIn				
				•••••		
NIU UID ★ hyster csis! - output	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
NIU UID ★ hyster csis! - output	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	
 VIU UID ★ hyster csis! - output to high , travisi! 	high-	to - L	.ow	and	Low	

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