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ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

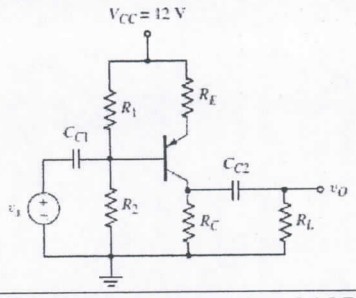
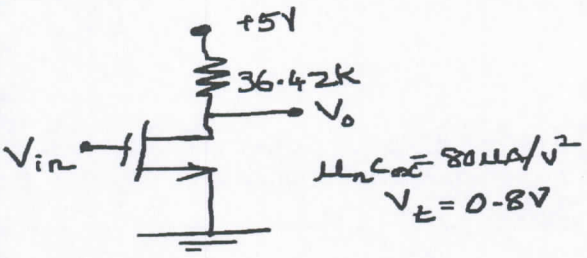
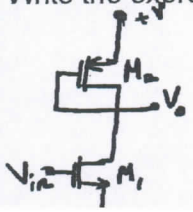
B.E. / B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, MAY/JUN 2024

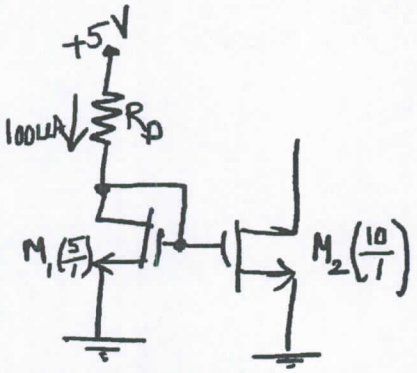
ELECTRONICS AND COMMUNICATION ENGINEERING
Semester III
EC7301 &Electronic Circuits I

(Regulation 2015)

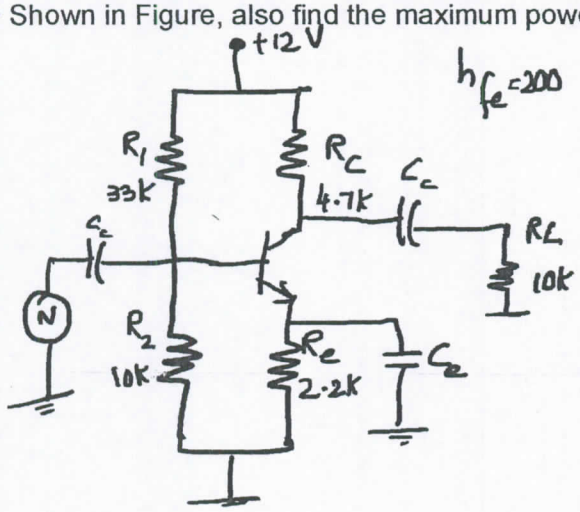
Time: 3hrs | Max.Marks: 100

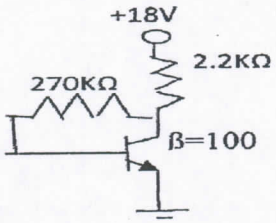
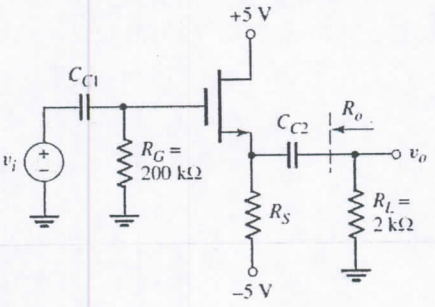
PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

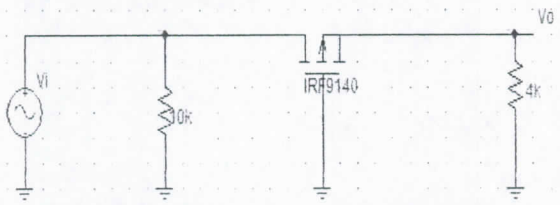
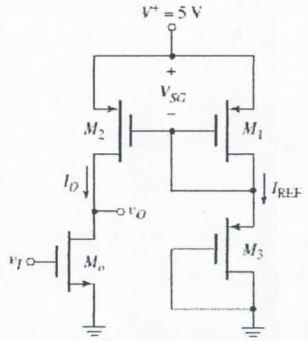
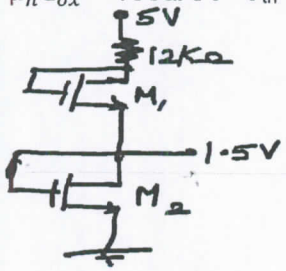
Q. No	Questions	Marks
1	If the coordinates of the operating point of a CE amplifier using base resistor method of biasing are V_{CE}=7V and I_C=1.5mA, determine the value of R_C and R_B	2
2	The circuit shown in figure has parameters R_E = 0.2 kΩ, R_C = 5 kΩ, R_1 = 15 kΩ, R_2 = 100 kΩ and R_L = 10 kΩ. The transistor parameters are β = 100, $V_{EB(on)}$ = 0.7 V, and V_A =∞. The circuit is biased with I_{CQ}=1.6mA and V_{CEQ}=5.11V. Draw ac load line characteristic and mention the slope of ac load line on the load line characteristic. 	2
3	A Common base amplifier has maximum gain of 125 and R_{in} is approximately equal to 26Ω. Find the value of R_C[R_L=∞ and R_S=0]	2
4	Define CMRR of differential amplifier	2
5	Find the aspect ratio of NMOS inverter shown in figure. 	2
6	Write the expression of voltage gain of circuit shown 	2

7	For an amplifier, mid band gain is 100 & lower cutoff frequency is 20KHz. Find the gain of an amplifier at frequency 20Hz.	2
8	The parameters of a transistor are: $\beta_0 = 120$, $f_T = 500MHz$, $r_\pi = 5k\Omega$ and $c_\mu = 0.2pF$. Determine C_π and f_β	2
9	Find the current I_{D2} in the circuit shown. 	2
10	Draw a PMOS current source and its equivalent circuit and derive for its output resistance.	2

PART- B (5 x 13 = 65 Marks)

Q. No	Questions	Marks
11 (a) (i)	Locate the operating point by drawing the dc and ac load lines of the circuit Shown in Figure, also find the maximum power delivered to the load RL . 	7
(ii)	Calculate the values of R_1 and R_C in the voltage divider bias circuit so that Q-point is at V_{CE}=6V and I_C=2mA. Assume the transistor parameters are α=0.985, I_{CBO}=4μA and V_{BE}=0.2V.	6
	(OR)	

11 (b) (i)	Determine the change in collector current produced in each bias referred in Figure . When the circuit temperature raised from 25°C to 105°C and I_{CBO}  =15nA @ 25°C	7
(ii)	Determine the transition point and minimum output voltage of an NMOS inverter with resistor load. Given V_{DD} = 5V, R_D= 20k, V_{TN} = 0.8 V and K_n= 0.2 mA/V^2	6
12 (a)	A CE amplifier uses load resistor R_C=2.5KΩ in the collector circuit and is given by the voltage source V_S of internal resistance 600Ω. The h parameters of the transistor are h_{ie}=1300Ω h_{re}=2*10^{-4},h_{fe}=55 and h_{oe}=22μ mhos. Neglecting the biasing resistor across the V_{CC} supply, compute the current gain A_I, input resistance R_i, Voltage Gain A_V, output Resistance R_0 and output terminal resistance R_{oT} for the following values of emitter resistor R_E inserted in the emitter circuit (i)200Ω (ii) 400Ω (iii)1000Ω. Use the approximate model for the transistor if permissible	13
	(OR)	
12 (b) (i)	A Germanium transistor CE amplifier biased by feedback resistor method,V_{CC}=20V,V_{BE}=0.2V,β=80 and the operating point is chosen such that V_{CE}=10.4V and I_C=9.9mA. Determine R_B and R_C	7
(ii)	For a Common Base amplifier driven by a voltage source of internal resistance R_S=600Ω, the load impedance is a resistor R_L=1200Ω. The h parameters are h_{ib}=22Ω, h_{rb}=4*10^{-4}, h_{fb}=-0.98 and h_{ob}=0.25μA/V. Compute the current gain A_I, the input impedance R_i, Voltage gain A_V, overall voltage gain A_{VS}, Overall Current gain A_{IS}, output impedance Z_0 and power gain A_P using exact and approximate analysis	6
13 (a)	Draw a common source amplifier with degenerative resistance (with feedback) and its equivalent circuit. Derive for its voltage gain, current gain, input resistance and output resistance.	13
	(OR)	
13 (b) (i)	For the source-follower circuit in Figure , the transistor parameters are: V_{TN} =0.8V, Kn = 1 mA/V^2, and λ = 0. Design the circuit such that $Ro \leq 200\ \Omega$. Determine the resulting small-signal voltage gain. 	7
(ii)	The small signal parameter of the NMOS transistor in the ac equivalent common gate circuit shown in figure are g_m=5mA/V and r_o= ∞. Determine the voltage gain and the input resistance.	6

		
14 (a)	Determine the frequency of a zero and a pole in the high frequency response of an emitter follower. Consider the emitter follower with parameters V^+ =5V, V^- =-5V, R_s=0.1kΩ,R_1=40KΩ, R_2=5.72kQ, R_e=0.5KQ, R_c=10KQ, β=150, C_π =35pf, C_μ=4pf, and I_{CQ}=1.02mA. Comment on its bandwidth.	13
	(OR)	
14 (b) (i)	In a Common Source amplifier for which the mid band voltage gain between gate and drain is -39, the NMOS transistor has C_{gs}=1.0 pf and C_{gd}=0.1pF. What is the input capacitance? For what range of signal source resistance the 3-dB frequency exceeds 1MHz?(Neglect the effect of R_G)	7
(ii)	A source follower has g_m=5mA/V, g_{mb}=0,r_π=20KΩ,R_L=2KΩ, C_{gs}=2pF, C_{gd}=0.1pF and C_L=1pF. Find A, R_o, f_z, frequencies of two poles and an estimate of f_H.	6
15 (a) (i)	The data for the CMOS amplifier shown in Figure are $V^+ = 5V$. The transistor parameters are are $V_{TN} = 1V$, $k_n' = 100\ \mu A/V^2$, $k_p' = 50\ \mu A/V^2$, $\left(\frac{W}{L}\right)_1 = \frac{20}{1}$, $\left(\frac{W}{L}\right)_2 = \frac{12}{1}$, $\left(\frac{W}{L}\right)_3 = \frac{3}{1}$ and $\lambda_n = \lambda_p = 0.02V^{-1}$. The quiescent input voltage and output voltage of the driver are 2V and 2.5V respectively. (i) Calculate I_{Ref} and I_O. (ii)Find A_V and W/L of driver. 	7
(ii)	Draw Widlar current source and derive for its output current and R_o	6
	(OR)	
15 (b) (i)	Draw a Current steering circuit with two sink and two source terminal. Derive the expressions for all the terminal currents in terms of the reference current.	7
(ii)	Calculate width of the devices M1 and M2 , Given L_1= L_2 =1 μm and I_D=120μA, $\mu_n C_{ox}$ =180uA/V^2 V_{tn} = 1V and λ=0 	6

PART- C (1 x 15 = 15 Marks)

(Q.No. 16 is Compulsory)

Q. No	Questions	Marks
16 (i)	Determine the differential and common mode gains of a differential amplifier: $V^+ = 10$ V, $V^- = -10$ V, $I_O = 0.8$mA, $R_C = 12k\Omega$, $\beta = 150$, RO= 22 kΩ, VA= ∞, source resistance $R_S = 0$. Use one sided output at V_{C1}	8
(ii)	The Darlington amplifier has the following parameters, $R_S = 3k\Omega$, $R_E = 3k\Omega$, $h_{ie} = 1.1$ KΩ, $h_{fe} = 50$, $h_{re} = 2.5 \times 10^{-4}$, $h_{oe} = 25\mu$mho. Then calculate A_I, R_I, A_V and R_0	7