İZMİR UNIVERSITY OF ECONOMICS
Department of Computer Engineering
ETE 232 Microelectronic Circuits and Devices
Spring 2011/2012

MIDTERM EXAM II

May 12, 2012
120 min

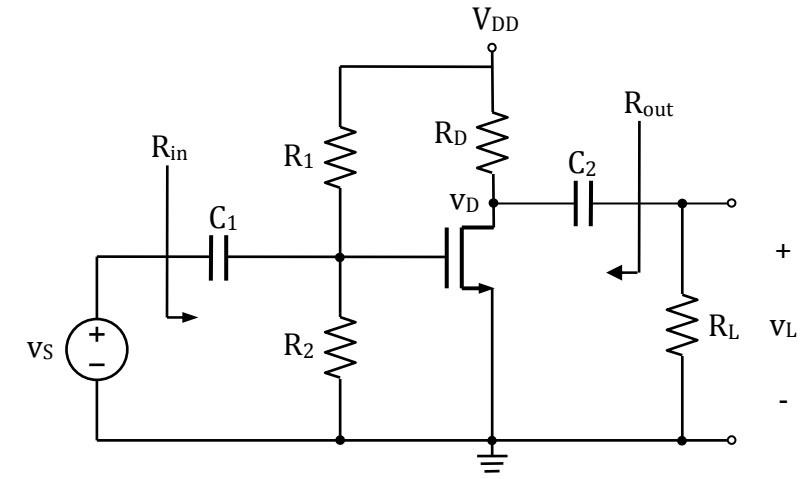
INSTRUCTIONS

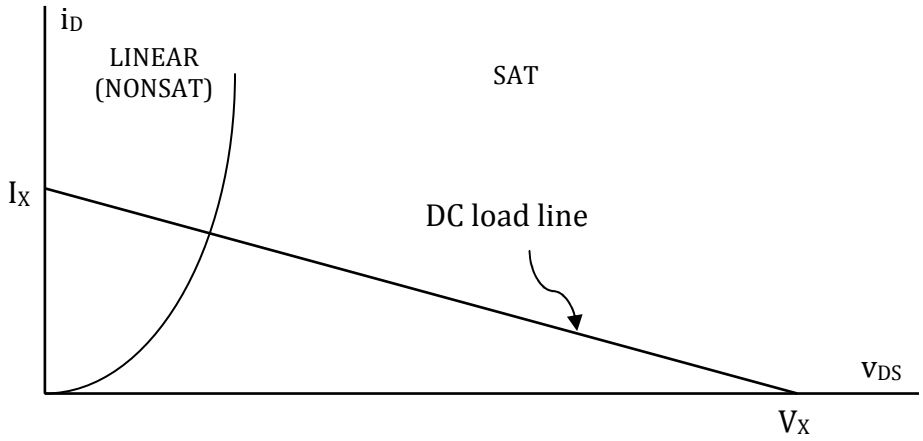
- Read all of the instructions and all of the questions before beginning the exam.
- There are 6 questions on this exam, totaling 100 points. The credit for each problem is given to help you allocate your time accordingly.
- Do not spend all your time on one problem and on one part and attempt to solve all of them.
- Calculators are allowed, but borrowing is not allowed.
- Your mobile phones must be turned off during the exam.
- Turn in the entire exam, including this cover sheet.
- You must show your work for all problems to receive full credit; simply providing answers will result in only partial credit, even if the answers are correct.
- Please indicate the number of page where your work is to be continued.
- Put your name on any additional material that you submit.
- Be sure to provide units where necessary.
- Please sign the honor pledge that is provided below.

	Question	Points	Grade
Last Name :……	1	25	
Name :……	2	25	
Section :……	3	25	
Student No :……	4	25	
	TOTAL		

The basic equations of the output characteristics of an NMOS transistor		
V_{GS}	**V_{DS}**	**I_D**
i) $V_{GS} < V_{Tn}$	-	0
ii) $V_{GS} > V_{Tn}$	a) $V_{DS} < V_{GS} - V_{Tn}$	$K_n\left[(V_{GS}-V_{Tn})V_{DS}-\frac{V_{DS}^2}{2}\right]$
	b) $V_{GS} - V_{Tn} \le V_{DS}$	$\frac{1}{2}K_n(V_{GS}-V_{Tn})^2$
where $K_n = K_n'\left(\frac{W}{L}\right)$ and $K_n' = \mu_n C_{ox}$,		

Q1. (25 pts) Consider the following amplifier. The DC and AC load lines of this amplifier are given below.





Circuit Parameters

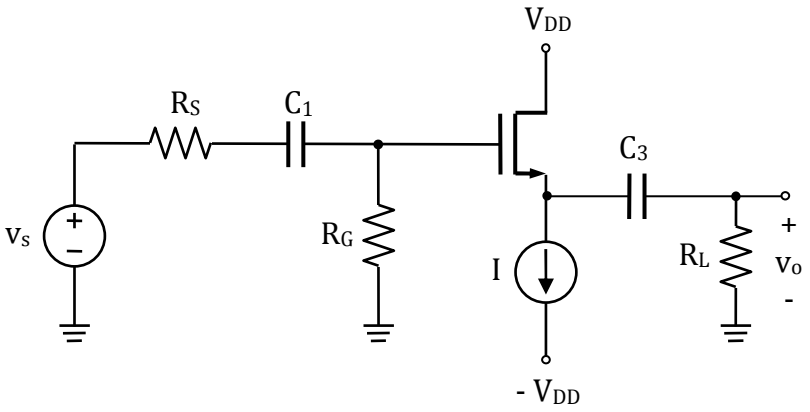
V_{DD} = 10 V
R_1 = 70 kΩ
R_2 = 30 kΩ
R_D = 2 kΩ
R_L = 6 kΩ

Transistor Parameters

V_{Tn} = 1 V
K_n = 1 mA/V^2
V_A = ∞

(a) Determine the points V_X and I_X on the DC load line.
(b) Determine the Q point values V_{DSQ} and I_{DQ}, and locate Q point on DC load line.
(c) Draw the AC load line. Indicate the x-axis and y-axis intercepts.
(d) Determine also the point where AC load line passes the LIN-SAT boundary.
(e) Determine the AC small signal voltage gain $A_V = v_O/v_S$.
(f) Determine R_{in} and R_{out}.
(g) Determine the total voltages v_D and v_L if $v_S = 0.1 \sin \omega_0 t$ volt.

Q2. (25 pts) Consider the common drain (source follower) circuit given below.



Circuit Parameters

V_{DD} = 15 V
I =1.5 mA
R_S = 6 kΩ
R_G = 6 kΩ
R_L = 9 kΩ

Transistor Parameters

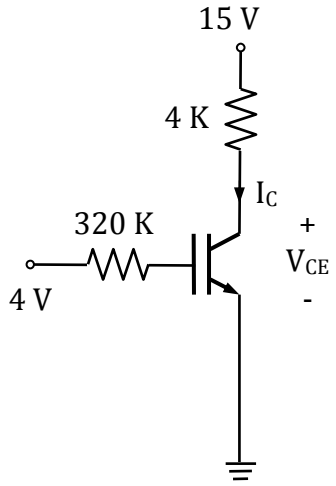
V_{Tn} = 1 V
K_n =3 mA/V^2
V_A = 60 V

a) Determine the quiescent point values V_{DSQ} and I_{DQ}.
b) Determine the small signal parameters g_m and r_{ds}.
c) Draw the AC small signal model of the circuit.
d) Determine the small signal voltage gain $A_V = v_o/v_s$.

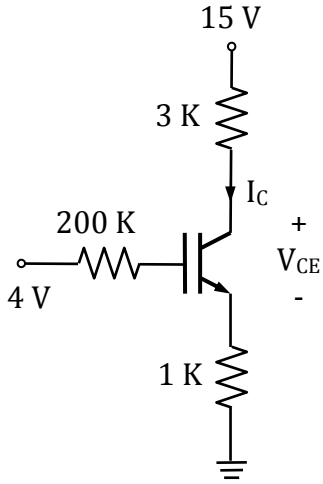
Q3. (25 pts) Consider the following BJT bias circuits.

a) Determine the state of the transistor in each circuit.
b) Determine the Q point values I_{CQ} and V_{CEQ}.
c) Compare the circuits (a) and (b) in terms of the Q-point stability, when β is doubled, i.e., β = 250.

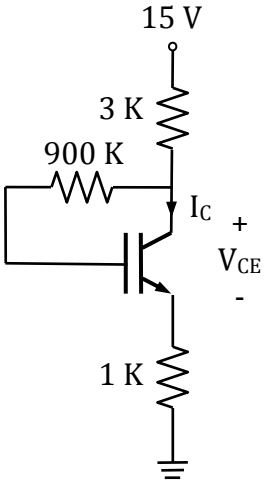
Transistor Parameters
β = 125
$V_{BE(on)}$ = 0.8 V
$V_{CE(SAT)}$ = 0.2 V



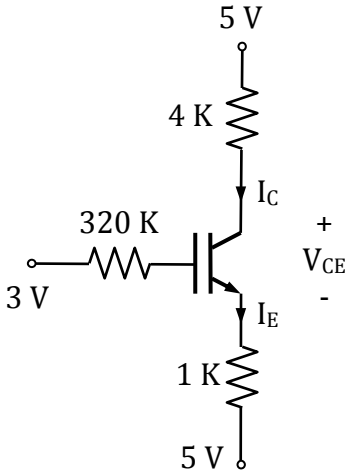
(a)



(b)

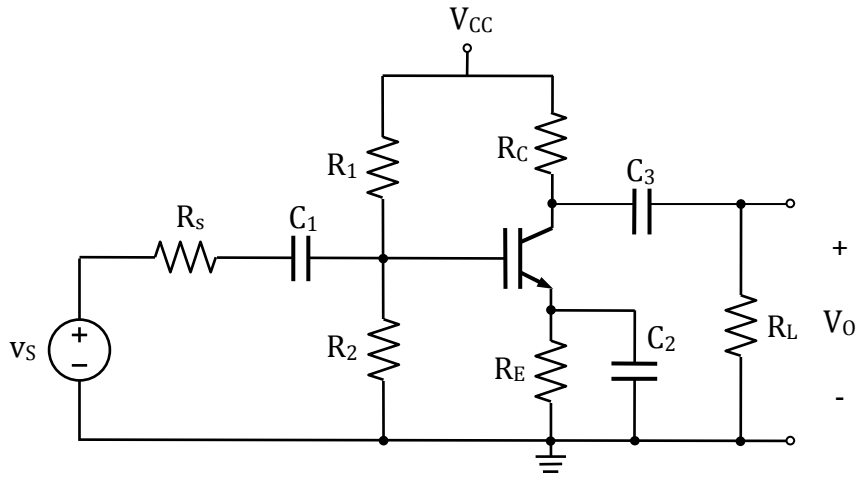


(c)



(d)

Q4. (25 pts) Consider the common-emitter amplifier given below.



Circuit Parameters

V_{CC} = 12 V
R_S = 1 kΩ
R_1 = 75 kΩ
R_2 = 25 kΩ
R_C = 5 kΩ
R_E = 1 kΩ
R_L = 10 kΩ

Transistor Parameters

$V_{BE(ON)}$ = 0.7 V
β = 100
V_A = 50 V

(a) Determine the Q point values V_{CEQ} and I_{CQ}.
(b) Determine the AC small signal voltage gain $A_V = v_O/v_S$.
(c) Draw the DC and AC load lines.
(d) Determine maximum peak value of the undistorted swing at the output.