Name: _____ Section: _____

Signature: _____ EEE 313 Fall 2015-2016

Bilkent University
Department of Electrical and Electronics Engineering
EEE 313 Electronic Circuit Design

Midterm 2 Makeup

11 January 2016, 9:30
(2 questions, 60 minutes)

- This is a **closed book**, closed notes exam. No cheat sheet allowed.
- All cell-phones should be completely **turned off**.
- Use a calculator for numerical computations. Carry at least **4 significant digits** during calculations. Your final answer should be at least **3 significant digits**.
- Be sure to write the **units** of all numerical results.
- **Show** all work clearly.
- Please put your **final answer** for each part inside a box for easy identification. Do not give multiple answers, they will not be graded.
- Do not remove the **staple** from the exam sheets or separate pages of the exam. All extra pages must be stamped to your exam.
- You may leave the exam room when you are done. However, please do not leave during the **last five minutes** of the exam.
- At the end of the exam, please stay seated until **all** exam papers are collected.

FET equations:

n-channel MOSFET

$i_D = K_n(v_{GS} - V_{Tn})^2$ SAT

$i_D = K_n\left[2(v_{GS} - V_{Tn})v_{DS} - v_{DS}^2\right]$ NON-SAT

p-channel MOSFET

$i_D = K_p(v_{SG} + V_{Tp})^2$ SAT

$i_D = K_p\left[2(v_{SG} + V_{Tp})v_{SD} - v_{SD}^2\right]$ NON-SAT

n-channel JFET

$i_D = \frac{I_{DSS}}{V_p^2}(v_{GS} - V_P)^2$ SAT

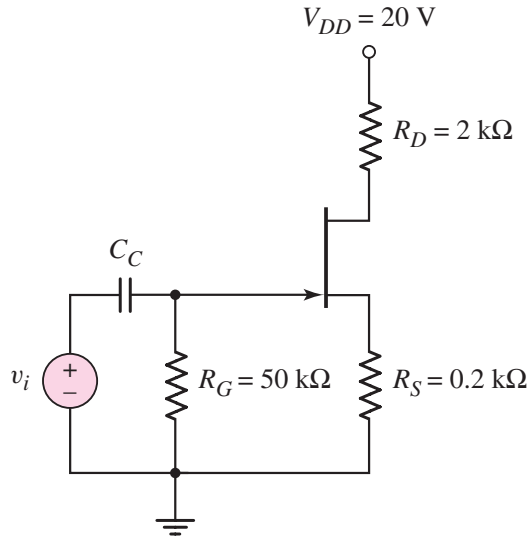
$i_D = \frac{I_{DSS}}{V_p^2}\left[2(v_{GS} - V_P)v_{DS} - v_{DS}^2\right]$ NON-SAT

Please do not write below this line

1. 25 pts.	
2. 25 pts.	
3. 25 pts.	
4. 25 pts.	
Total 100 pts.	

1. (50 points) For the transistor in the circuit in the figure, the parameters are: $I_{DSS} = 10$ mA and $V_P = -5$ V. Determine I_{DQ}, V_{GSQ}, and V_{DSQ}.

I_{DQ}	V_{GSQ}	V_{DSQ}



2. (50 points) At the circuit given above, the transistor is an n-channel enhancement mode MOSFET with $V_{TN} = 1.5$ V and $K_n = 3\text{x}10^{-3}$ A/V^2. R_D=400 Ω and R_L=1000 Ω. Answer the following:

a) Derive the equation for g_m in terms of K_n and I_d assuming saturation.
b) The drain current turns out to be 10mA and the transistor is at saturation. Draw the AC equivalent circuit.
c) Find the voltage gain of the amplifier defined as Vo/Vin assuming that C_{in}, C_o and C_1 are very large.
d) Find the input and output impedances of the amplifier again assuming that C_{in}, Co and C_1 are very large.
e) Find a condition (an inequality), which imposes a limit on C_{in} if the frequency of operation is 500Hz.