

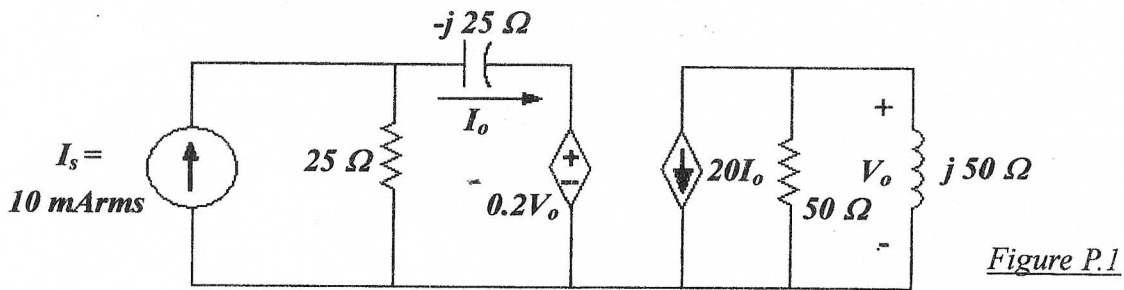
94 學年度 動力機械 系(所) 乙 組碩士班入學考試

科目 電路學及電子學 科目代碼 1602 共 長 頁第 壹 頁 *請在試卷【答案卷】內作答

Note: Assuming whatever variablse and/or parameters if necessary.

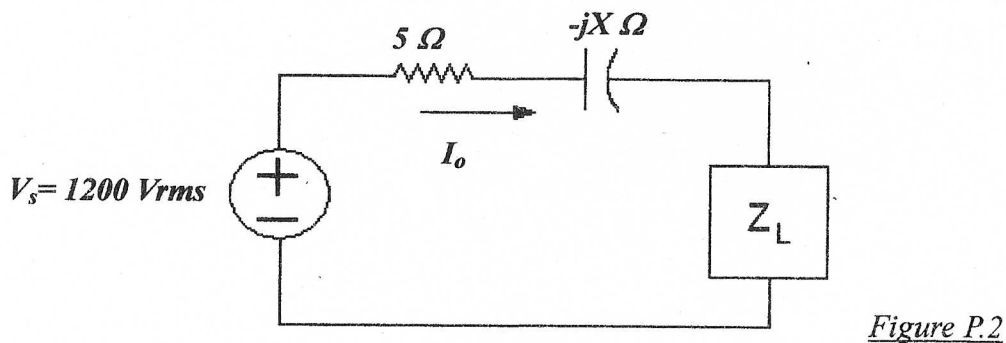
Prob. 1 Consider the circuit as shown in Fig. P.1 with all the values expressed in phasor.

- Find V_o and I_o (in phasor expression). (12 pts)
- Calculate the power supplied by the current source I_s (6 pts)



Prob. 2 The inductive load impedance Z_L in Fig. P.2 has a magnitude of 125Ω and absorbs an average power of $7.5 kW$, while the sinusoidal voltage source V_s supplies an average power of $8 kW$ at a frequency of $60 Hz$ through a 5Ω resistor in series with a capacitor on the line to the load.

- Find the equivalent resistance and inductance of Z_L . (8 pts)
- Determine the capacitance of the line. (8 pts)
- Calculate $i_o(t)$ in A_{rms} . (6 pts)



Prob. 3 Single choice problems; please choose **only one** answer for each problem; 0.4 point will be counted for wrong answers. (20 pts)

- Alex has to design the mixer circuits of an audio amplifier before prototyping; what is the most important concept if he wants to assume the mixer to be linear? (A) Thevinin Theorem, (B) Norton Theorem, (C) Principle of Superposition, (D) Miller Theorem, (E) Einstein Relationship of PN Junction.

Please turn to next page

2. In semiconductor crystal structure, free electrons and holes move randomly through the structure in the process which results in some electrons may fill some of the holes; the process is called (A) drift, (B) recombination, (C) diffusion, (D) breakdown, (E) thermal ionization.
3. Which of the followings is **not** the basic characteristics we would assume for ideal operational amplifiers? (A) slew rate, (B) infinite input impedance, (C) zero common mode gain, (D) infinite bandwidth, (E) zero output impedance.
4. In design of bipolar junction transistors (BJT), what is the most wanted condition of doping majority-carrier concentrations for appropriate BJT characteristics? (A) $n_B > n_E > n_C$, (B) $n_E > n_B > n_C$ (C) $n_C > n_B > n_E$, (D) $n_C > n_E > n_B$, (E) $n_E > n_C > n_B$.
5. Brian wants to use a pair of BJTs for his small project of making an audio booster on his PC speakers. The input signal from his MP3 player is $1 V_{p-p}$; and, the power output of his speakers is 0.2 watt at 8 ohms impedance. What is the best configuration for Brian's BJT amplifier? (A) common emitter, (B) common base, (C) cascode, (D) common collector, (E) differential.
6. What is the true statement for a voltage doubler circuit consists of two diodes and two capacitors? (A) The two capacitors have AC voltage. (B) The two diodes have DC voltage. (C) One capacitor parallels to the output terminal. (D) Input source can be DC voltage. (E) Two capacitors are directly connected.
7. Choose the most **unnecessary** component in the followings for a DC power supply with input being a 110 volt AC source. (A) light emitting diodes. (B) rectifier diodes. (C) power transformer. (D) filter capacitors. (E) voltage regulator.
8. Christie just finished a BJT amplifier circuit on the breadboard. What would she measure with an oscilloscope on the output for her common collector configuration BJT amplifier if she connect $10 mV_{p-p}$ input signal to the circuit if the bias of the BJT is normal? (A) $1 V_{p-p}$ in phase, (B) $10 mV_{p-p}$ inverse phase, (C) $1 mV_{p-p}$ in phase, (D) $10 mV_{p-p}$ in phase, (E) 0 V.
9. In describing the $i_D - v_{GS}$ characteristics of MOSFET, what is the most irrelevant terminology to be considered in the followings? (A) channel length modulation, (B) saturation region, (C) triode region, (D) process transconductance parameter, (E) W/L ratio.
10. For a BJT amplifier, the power supply is 20 volt DC with the amplifier being common emitter configuration. If the output swing of the amplifier is smaller than $10 V_{p-p}$, what is the most appropriate value of V_{CEQ} of the BJT? (A) 5 volt, (B) 10 volt, (C) 15 volt, (D) 15 volt, (E) 20 volt.

Prob. 4 For the precision rectifier OP AMP circuit as shown in Fig. P.4, find the output waveform v_o when the input v_i is a symmetric sine wave of $2 V_{p-p}$, 10 Hz frequency; the diode D is assume to be ideal. (5 pts)

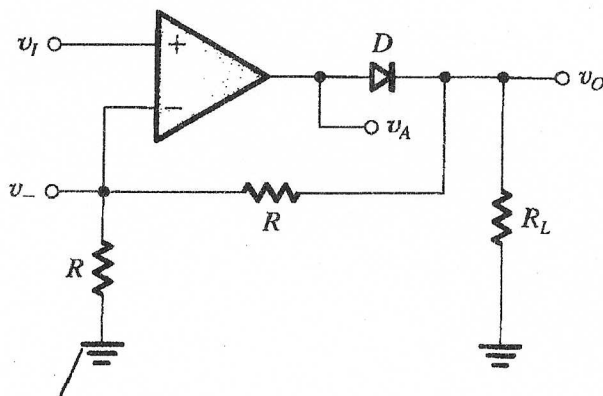


Figure P.4

Prob. 5 For the common source MOSFET amplifier as shown in Fig. P.5, calculate the voltage gain A with the given MOSFET parameters: $V_t = 1V$, $k'_n W/L = 1 \text{ mA/V}^2$, and $\lambda = 0$. Hint: you have to start with DC analysis. (5 pts)

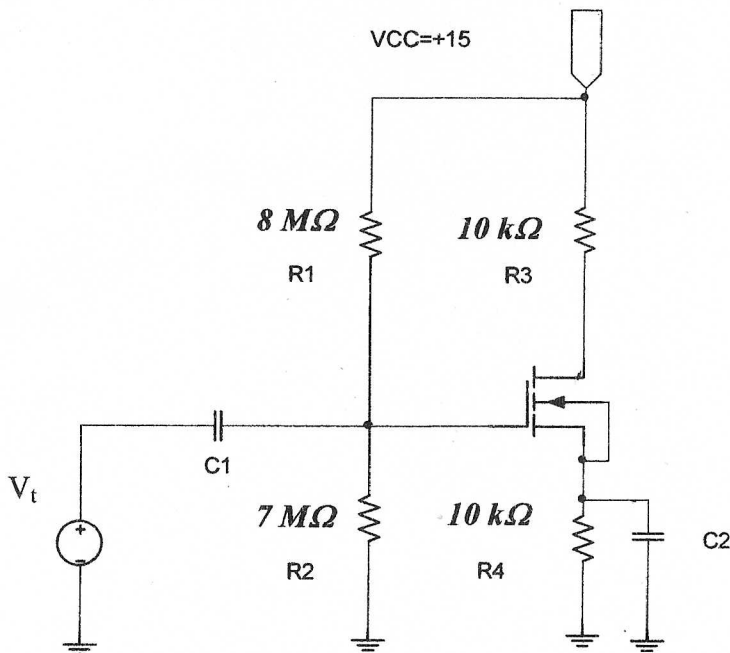
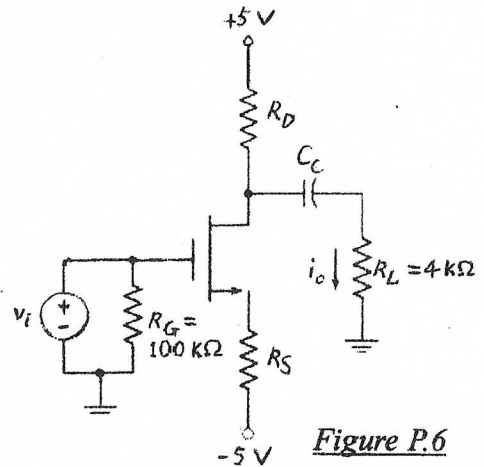


Figure P.5

Prob. 6 The transistor in the circuit in Fig. P.6 has conduction parameters $K_n = (W\mu_n C_{ox}/2L) = 1 \text{ mA/V}^2$, threshold voltage $V_{TN} = 1 \text{ V}$, and channel-length modulation $\lambda = 0$.

- (a) Design the circuit (i.e., find R_D and R_S) such that the quiescent current $I_{DQ} = 1 \text{ mA}$ and the quiescent voltage $V_{DSQ} = 3 \text{ V}$. (5 pts)
- (b) Draw the small-signal equivalent circuit and derive the expression for the transfer function $T(s) = I_o(s)/V_i(s)$. (10 pts)



Prob. 7 Consider the current source in Fig. P.7. (a) Derive the expression for R in terms of W/L ratios, quiescent currents, and conduction parameters of the transistors. Assume that the PMOS devices are all matched. (8 pts). (b) Determine $(W/L)_5$ and $(W/L)_6$ such that $I_{O1} = 25 \mu\text{A}$ and $I_{O2} = 75 \mu\text{A}$. Assume transistor parameters are $V_{TN} = +0.5 \text{ V}$, $V_{TP} = -0.5 \text{ V}$, $(1/2)\mu_n C_{ox} = 50 \mu\text{A/V}^2$, $(1/2)\mu_p C_{ox} = 20 \mu\text{A/V}^2$, and $\lambda_n = \lambda_p = 0$. The W/L ratios are given for the $M_1 - M_4$ transistors as shown. (7 pts)

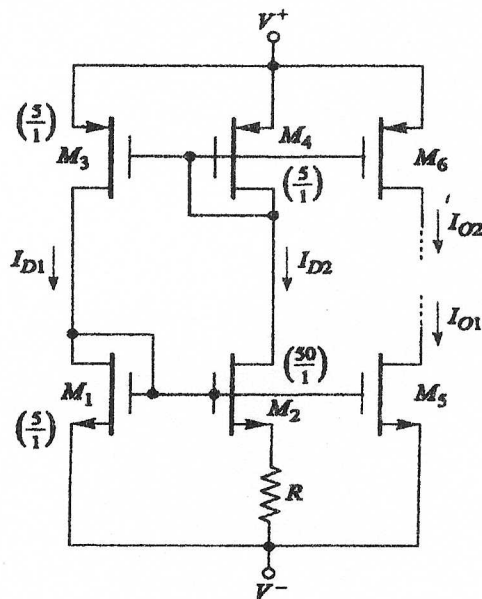


Figure P.7