

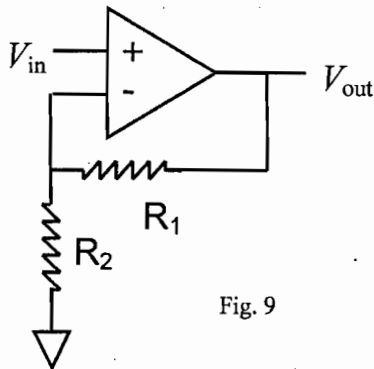
國立台灣科技大學九十五學年度碩士班招生試題

系所組別：光電工程研究所碩士班

科目：電子學與近代物理

總分 100 分

1. What is the maximum wavelength of light that will cause photoelectrons to be emitted from sodium? What will the maximum kinetic energy of the photoelectrons be if 200-nm light falls on a sodium surface? Where the work function of sodium is 2.3 eV, Plank constant $h = 6.626 \times 10^{-34}$ J-s = 4.136×10^{-15} eV-s, speed of light $c = 3 \times 10^8$ m/s. (6%)
2. Find the shortest wavelength present in the radiation from an x-ray machine whose accelerating potential is 50,000 V. (4%)
3. A positronium "atom" is a system that consists of a positron and an electron that orbit each other. (a) Compare the wavelengths of the spectral lines of positronium with those of ordinary hydrogen. (b) Compare the ionization energy in positronium with that in hydrogen. (6%)
4. The Fermi energy in silver is 5.51 eV. What is the average energy of the free electrons in silver at 0 K? (4%)
5. Phosphorus is present in a germanium sample. Assume that one of its five valence electrons revolves in a Bohr orbit around each P^+ ion in the germanium lattice. If the effective mass of the electron is $0.17 m_e$ and the dielectric constant of germanium is 16, find the radius of the first Bohr orbit of the electron. (5%)
6. Describe briefly the physical processes of (a) avalanche and (b) Zener breakdown in $p-n$ junctions. (8%)
7. Describe briefly the effect of temperature on diode characteristics. (8%)
8. Please draw schematic diagrams of the full I-V characteristics of a bipolar junction transistor in the common base and the common emitter configurations. (9%)
9. (10%) For the circuit shown in Fig. 9 with $R_1/R_2=9$, find the minimum differential gain of the OPAMP to make the close loop gain error (the deviation from nominal close loop gain) less than 1%. Assume that the other parameters of the OPAMP are ideal.



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10. (25%) Refer to the circuit in Fig. 10
- Use small signal models to deduce or estimate the voltage gain $V_{out}/(V_{in1}-V_{in2})$. (15%)
 - If V_{out} is connected V_{in2} to form a unity gain buffer, deduce or estimate the output swing. (10%)
11. (15%) Under the maximum output swing condition, find the maximum power conversion efficiency of the amplifier shown in Fig. 11. Assume $L \gg 1$, R_E & R_{coil} (of coil L) $\ll 1$ and the output current is sinusoidal.

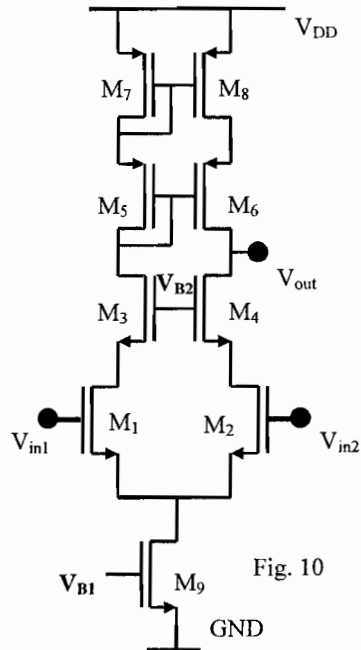


Fig. 10

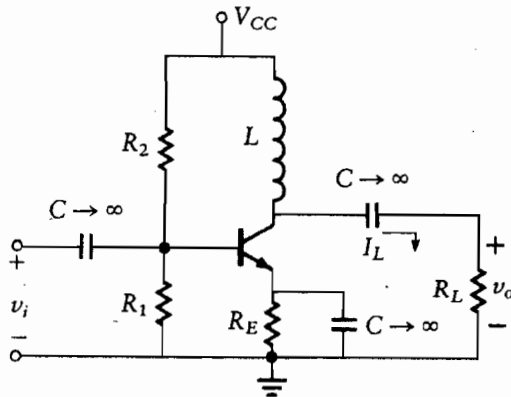


Fig. 11

