

國立成功大學

113學年度碩士班招生考試試題

編 號：155

系 所：生物醫學工程學系

科 目：電子學

日 期：0201

節 次：第 2 節

備 註：可使用計算機

※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

- (20%) Please elucidate the following terminologies commonly employed in microelectronics: **a)** “drift and diffusion,” detailing the movement of charge carriers, **b)** the roles of “bypass capacitor” and “coupling capacitor” in circuit functionality, **c)** the significance of the “3-dB point” in Bode plots for frequency response analysis, and **d)** the concept and advantages of “3D-IC” technology.
- (20%) What is the primary purpose of an Automated External Defibrillator (AED), and how can microelectronics expertise contribute to its design?
- (20%) A Darlington pair is a compound structure of two bipolar junction transistors (BJTs) connected in such a way that the current amplified by the first transistor is further amplified by the second one. This configuration results in a high current gain and is commonly used in power amplification and switching applications.

Given the following parameters: $V_{CC} = 15\text{ V}$, $R_C = 1\text{ k}\Omega$, $R_B = 100\text{ k}\Omega$, $V_{BE} = 0.7\text{ V}$, for each transistor, the current gain β of each transistor is 100.

- Design and draw the circuit diagram of a Darlington pair using NPN transistors. Include the power supply, and all relevant resistors.
 - Calculate the overall current gain (β_{total}) of the Darlington pair.
 - Determine the base current (I_B), collector current (I_C), and the voltage drop across the collector resistor (V_{RC}) when the pair is in active mode.
- (20%) Please derive the transfer function and draw the frequency response of a common-emitter (CE) (as shown in Figure 2) amplifier in low-frequency band, mid-gain band, and high-frequency band.
 - (20%) Transfer function of a second-order low-pass filter can be expressed as $T(s) = \frac{a_0}{s^2 + s\frac{\omega_0}{Q} + \omega_0^2}$ and the

magnitude response is shown in Figure 1, please derive that $\omega_{max} = \omega_0 \sqrt{1 - \frac{1}{2Q^2}}$.

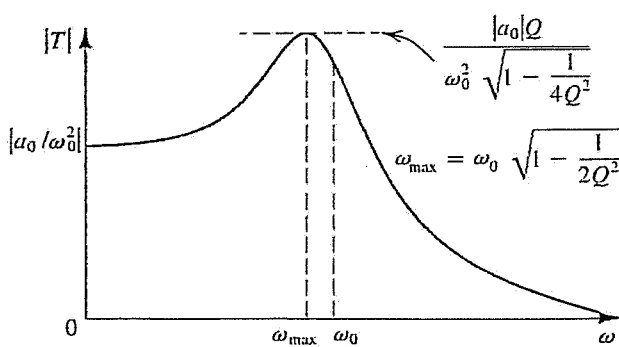


Figure 1

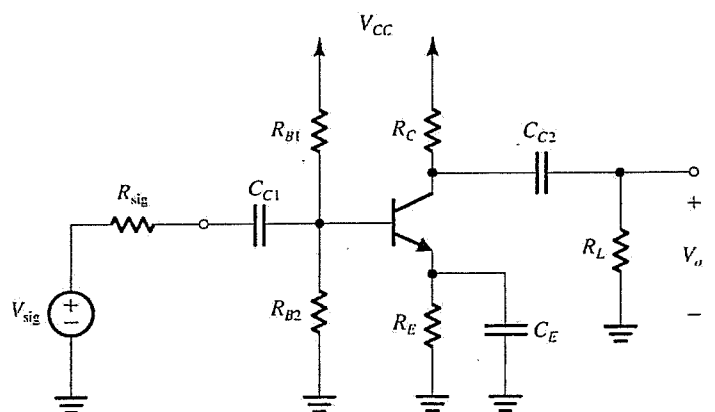


Figure 2