EE2255 電 子 學 **Quiz 3 (Ch4/5)** **Spring 2021**

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Part I (50%)

For the following questions, please choose the most appropriate answer:

(C) 1. For a npn BJT with V_{BE} = 0.8V, V_{CE} = 1V, which mode does this transistor operates in?
(A) Saturation; **(B)** Reverse active; **(C)** Active; **(D)** Cut off.

(A) 2. For a npn BJT, which statement is true?
(A) Election diffusion in base determines the collector current
(B) Hole drift current in base determines the base current
(C) Election drift current in base determines the collector current
(D) Hole diffusion in base determines the emitter current

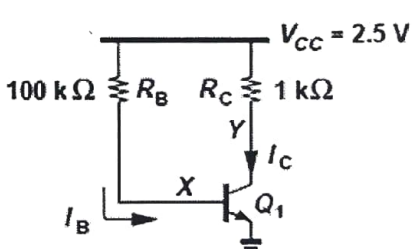
(C) 3. Most of the holes in the base of a pnp transistor in active mode flow:
(A) into its emitter; **(B)** into its base; **(C)** into its collector; **(D)** out of its base

(B) 4. Which of the following parameter will NOT affect the transconductance (g_m) of a BJT?
(A) Collector current; **(B)** Early voltage; **(C)** V_{BE}; **(D)** Temperature

(D) 5. For a npn BJT in active mode with all device parameters and bias voltages fixed, while the I_S changes by increasing the emitter area, which factor will remain the same.
(A) Collector current; **(B)** Output resistance; **(C)** Base current; **(D)** Early voltage

Part II (50%) For the npn transistor, let $V_{CE,sat}$ = 0.4V, $\beta = 100, V_T = 26mV$

1. For the circuit on the right, let Q1 with $V_{BE,on}$ = 0.8V.
   (a) Find Ic and I_B.
   (b) Find the voltage at point Y.
   (c) Find the small-signal parameters, r_π, and g_m of Q_1
   (d) What is the maximum allowable value of Rc to keep Q_1 in active region?



(a) $I_B = \frac{V_{CC} - V_{BE}}{R_B} = 1.7 \cdot 10^{-5}$ A

$I_C = \beta I_B = 1.7 \cdot 10^{-3}$ A

(b) $V_Y = V_{CC} - I_C R_C = 0.8$ V

(c) $g_m = \frac{I_C}{V_T} \doteq 0.0654$ S

$r_\pi = \frac{\beta}{g_m} \doteq 1529\ \Omega$

(d) $V_{CC} = V_{CE} + R_C I_C$

$2.5 = 0.4 + R_C \times 1.7 \cdot 10^{-3}$

$R_C \doteq 1235\ \Omega$