End Semester Examination

EE2104: Semiconductor Device Fundamentals

Time Allotted: 55 minutes
Total Marks: 48
Bonus Question: 18- 2 marks [So you can score 50/48]

SECTION 1: NUMERICAL QUESTIONS (3 MARKS EACH)

1. If a semiconductor is transparent to light with a wavelength longer than 0.87um, what is its band-gap energy?

2. Calculate the diffusion coefficient of an electron at room temperature if its mobility in a given material is $1900 \text{cm}^2/\text{Vs}$

3. A transistor in CE mode is connected with a resistance of 5kΩ and a power supply of 5V in the collector circuit. If $\alpha = 0.998$ and the voltage drop across the 5kΩ resistor is 5V, find the base current.

4. Find the hole concentration in a doped semiconductor with intrinsic carrier concentration 2.5×10^{13} where the doping is Arsenic with a concentration of 10^{17}

5. In a common base connection, the emitter current is 1mA. If the emitter circuit is open, the collector current is 50uA. Find the total collector current if $\alpha = 0.92$

6. Find the current in a bridge rectifier circuit with forward resistances of all the silicon-based diodes used equal to 1Ω and an external resistance of 10Ω connected across a 3V supply.

SECTION 2: FILL IN THE BLANKS (1 MARK EACH)

7. In _____ type MOSFET, there is no inbuilt channel present.
8. Once pinch-off occurs in a JFET, the device acts as a _____ source.

9. For p-JFET, the channel is _____ type, and the gates are _____ type.
10. JFET is a _____ controlled three terminal device.
11. A Zener diode is a _____ doped pn junction diode, due to which the depletion region is _____ and the electric field is _____.
12. A special purpose diode formed by a metal and a semiconductor is called a _____ diode.
13. _____recombination involves three charge carriers.

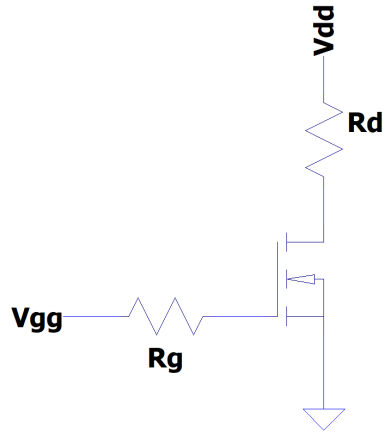## SECTION 3: NUMERICAL QUESTIONS (5 MARKS EACH)

14. If, $V_c = 9$V and $\beta = 75$, find the ratio of R_B and R_C for the following network:
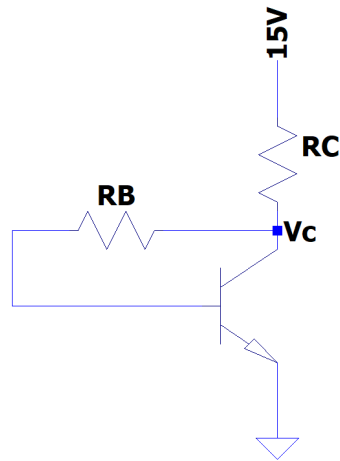
15. Find the values of R_C and R_E, if $R1 = R2 = 90k\Omega$, $V_o = 0$V, $V_{CE} = 3$V, $\beta = 200$ for the following network:
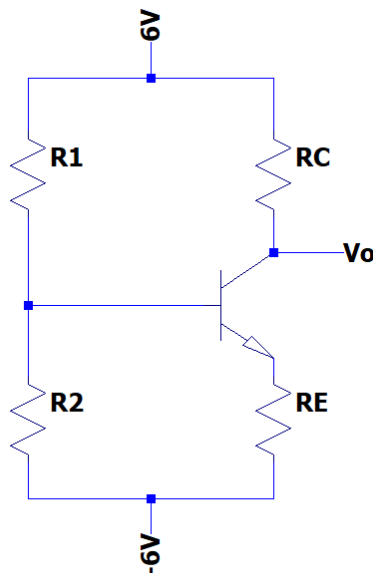
16. Find the operating point for the following nmos-based circuit if $R_g = 1k\Omega$, $R_d = 2.2k\Omega$, $V_{dd} = 10V$, $V_{gg} = -5V$, and $I_{dss} = 16mA$:

17. Determine the Q point and find the maximum peak value of the base current for linear operation. Assume $\beta_{dc} = 200$
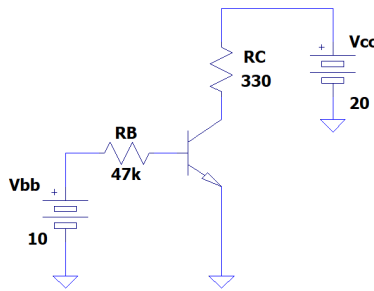
18. [Bonus, 2 Marks] In a certain transistor, 99.6% of the charge carriers injected into the base cross the collector-base junction. If the leakage current is $5\mu A$, and the collector current is 20mA, find the value of α_{dc} and emitter current.