Comments of the students' performance in EE2021, AY2014/15 Semester 2

Q1. True/False Question : No comments.

Q2. (a) Most students are able to estimate β, but few are able to provide the reason for the choice of Point A (which is in the forward active region of operation of BJT) for the estimation. In fact, most did not provide the reason.

Some students showed confusion between the different operation regions of BJT and MOSFET, e.g., some students state that Point A is in the linear or saturation operation region.

(b) Few students show a clear understanding of Early effect in BJT.

(c) Few students show a clear understanding of the effect of doping concentration in emitter, base and collector on I_C and I_B.

(d) Very few students show understanding of the effect of the base doping concentration on Early voltage.

Q3. (a) Some students do not know the unit for capacitance per unit area (i.e., F/cm^2).

Some students show difficulty in getting the right answer given the mix of units used for length (i.e., cm and nm).

Some students do not know the difference between permittivity and relative permittivity.

(b) Students show difficulty in getting the right answer given the mix of units used for length (i.e., cm, nm, and μm).

(c) Quite a lot of students have difficulty in evaluating V_{DS} from V_{GS} and V_{GD} (i.e., $V_{DS} = V_{DG} - V_{GS}$).

A few students show confusion between linear and saturation operation regions of MOSFET.

Q4. (a) A common error made by the students was to try to calculate the value of I_C assuming V_{BE} = 0.7V using the formula $I_C = I_S \{exp (V_{BE}/nV_T) -1 \}$. They did not see that I_E was fixed at 0.75mA by the current source.

(b) Most students got part (b) correct.

(c) Some students did not identify the components of the 2 port network correctly, and many missed out R_c.

(d) Many students took R_{out} to be equal to r_o, and neglected the effect of R_c.

(e) Most students who managed to do (a) to (d), managed to get part (e) correct.

Q5. (a) Most students were able to draw the pull down network (PDN) correctly.

Some students did not indicate the logic output (Y) and/or the ground in the PDN. A few indicated $\overline{Y}$ as the logic output.

(b) Some students did not take into account that the sizing of the logic circuit, which is $2(W/L)_{min}$, is different from that of the inverter, which is $(W/L)_{min}$.

Some students made the mistake by taking the ratio of t_{PHL} to be directly proportional to, instead of inversely proportional to, the effective transistor sizing of the logic circuits.

Q6. (a) Some students included R_{S1} in the equivalent resistance, when it should not be included because it is short-circuited out by the parallel capacitor in the ac equivalent circuit.

(b) Some students did not include the brackets that are necessary in the equivalent resistance expression, such as writing $\frac{1}{g_{m,M1}} // R + \frac{R_{BB}}{1+\beta} + \frac{1}{g_{m,Q1}}$ instead of $\frac{1}{g_{m,M1}} // \left(R + \frac{R_{BB}}{1+\beta} + \frac{1}{g_{m,Q1}} \right)$.

Some students did not indicate the appropriate subscript ($M1$ or $Q1$) in the expressions, such as that above.

Q7. Some students confused the question as one for a PN junction, instead of a non-uniformly doped piece of n-type semiconductor.

(a) The students generally can provide the correct answer on whether there is an electric field. But the explanation on why there is the electric field is not complete enough.

(b) The students generally can calculate the electric field and indicate the direction correctly.

(c) The students generally can calculate the current density and indicate its direction correctly.

(d) Most of the students cannot answer 7(d) correctly as they did not calculate the dn/dx value. Constant dn/dx value gives the constant electron diffusion current density.

Q8. (a) Most students get this part right.

(b) Many students did not split current in 2 branches as I and (2-I). The common errors were to take current as I or 2 mA for all devices instead. This led to the wrong gain expression and the maximum gain cannot be found if they make this mistake.

(c) Some students wrongly concluded that M_4 is a diode connected transistor as M_3 is a diode connected transistor. They therefore expressed the ac equivalent resistance of M_4 incorrectly, which led to low output resistance and lower gain which is wrong.

Q9. Some students could not analyse the Op-Amp circuit correctly in part (a) to get the correct expression. As a result, the values of R_1, R_2 and R_3 in part (b) are also wrong.