

EE431 / EE531 Equation Sheet

Return sheet with test – do not mark in any way

Test rules: (you are only one cheating incident away from academic misconduct)

- ✓ Do all work on the test. Use the backside if necessary. **Extra paper is not allowed.**
- ✓ Equations/data are supplied on the test. You may have no other notes.
- ✓ **All sheets of the test must remain stapled – do not remove any page.**
- ✓ You may have 1 approved calculator as described later in this document. However, for some tests it is possible that no calculator will be allowed.
- ✓ All other papers, books, purses, bags, etc. must be off the desk and on the floor out of site.
- ✓ You may have no cell phones, pagers, etc. in view. Any devices you have with you must be OFF unless approved by the instructor.
- ✓ Your desk must be free of anything not approved – thus you have only three items: the test, your calculator (if permitted for the test), and your pencils/erasers – none of which can contain any notes.
- ✓ Caps or any kind of head gear are not allowed.
- ✓ Nothing can be in your lap or off the desktop, even if legitimate for the test.

General data and equations:

Standard R: 10 11 12 13 15 16 18 20 22 24 27 30 33 36 39 43 47 51 56 62 68 75 82 91

Standard C: 10 12 15 18 22 27 33 39 47 56 68 82

$V_{BE_{nom}}$ at 25 C = _____ volts dV_{BE}/dT = _____ mV/C

$$T_C = (T_F + 40) \left(\frac{5}{9} \right) - 40 \quad T_F = (T_C + 40) \left(\frac{9}{5} \right) - 40 \quad T_K = T_C + 273$$

$k = 1.38E-23$ J/C $|e| = 1.602E-19$ C

$$NG = \frac{1 + \frac{R_f}{R_i}}{1 + \frac{R_f}{R_i} + \frac{1}{A_v}} \quad IG = \frac{-\frac{R_f}{R_i}}{1 + \frac{R_f}{R_i} + \frac{1}{A_v}} \quad Gain = 1 + 2 \left(\frac{R_f}{R_g} \right)$$

Real Op-Amp A_v = _____ Ideal Op-Amp A_v = infinity

V_{os} = _____ mV I_B = _____ nA I_{BOS} = _____ nA

E_n = _____ nV/ \sqrt{Hz} I_n = _____ nA/ \sqrt{Hz}

$$V_o|_{V_{os}} = -V_{os} \times NG \quad V_o|_{I_B} = I_B (R_I - R_N) NG \quad V_o|_{I_{BOS}} = \left(\frac{I_{BOS}}{2} \right) (R_I + R_N) NG$$

Note: Use absolute value of the above. Note: E_n and I_n are in per root Hz units below.

$$V_n = \sqrt{4kTB R} \quad P_n = kTB \quad 1^{st} \text{ order: } N_{BW} = \left(\frac{\pi}{2} \right) F_{-3dB}$$

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$$V_{O_n}|_{R_s} = V_n|_{R_s} \times NG$$

$$V_{O_n}|_{R_i} = V_n|_{R_i} \times IG$$

$$V_{O_n}|_{R_f} = V_n|_{R_f}$$

$$V_{O_n}|_{E_n} = (E_n \sqrt{B}) NG$$

$$V_{O_n}|_{I_{B+}} = (I_n \sqrt{B}) R_N NG$$

$$V_{O_n}|_{I_{B-}} = (I_n \sqrt{B}) (R_f \parallel R_i) NG$$

$$\omega = 2\pi F \quad F_c = \frac{1}{2\pi T} \quad GBW = F_c \times NG$$

$$n = \frac{\ln \left(\frac{\frac{1}{R_s^2} - 1}{\frac{1}{R_p^2} - 1} \right)}{2 \ln \left(\frac{F_s}{F_p} \right)}$$

$$F_{CL} = \frac{F_p}{e^{\left(\frac{\ln \left(\frac{1}{R_p^2} - 1 \right)}{2n} \right)}}$$

$$F_{CH} = \frac{F_s}{e^{\left(\frac{\ln \left(\frac{1}{R_s^2} - 1 \right)}{2n} \right)}}$$

$$F_c = \frac{F_{CL} + F_{CH}}{2} \quad n = \frac{\cosh^{-1} \left[\sqrt{\frac{\frac{1}{R_s^2} - 1}{\frac{1}{R_p^2} - 1}} \right]}{\cosh^{-1} [F_s / F_p]}$$

$$\frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

$$\omega_n = \frac{1}{\sqrt{R_1 R_2 C_1 C_2}}$$

$$\zeta = \frac{R_1 + R_2}{2} \sqrt{\frac{C_2}{R_1 R_2 C_1}}$$

$$\zeta = \frac{1}{2Q}$$

$$C = 4 \times 10^{-7} / \sqrt{F_n}$$

$$C_1 = C / \zeta$$

$$0.1 \times \zeta^2 C_1 < C_2 < \zeta^2 C_1$$

$$K_C = C_2 / C_1$$

$$K_R = \frac{2\zeta^2 - K_C + 2\zeta \sqrt{\zeta^2 - K_C}}{K_C}$$

$$R^2 = \frac{1}{\omega_n^2 C_1 C_2}$$

$$R_1 = \sqrt{\frac{R^2}{K_R}}$$

$$R_2 = \frac{R^2}{R_1}$$

$$\text{discharge: } V_{(t)} = (V_{init} - V_{low}) e^{-t/T} + V_{low}$$

$$\text{charge: } V_{(t)} = V_{init} + (V_{high} - V_{init}) (1 - e^{-t/T})$$

$$F = \frac{1.44}{(R_1 + 2R_2)C}$$

$$T_J = P_D \theta_{JA} + T_A$$

$$\text{Line_regulation} = \frac{V_o @ \text{Line_high} - V_o @ \text{Line_low}}{V_o @ \text{Line_nom}} \times 100\%$$

$$\text{Load_regulation} = \frac{V_o @ \text{no_load} - V_o @ \text{full_load}}{V_o @ \text{no_load}} \times 100\%$$

$$V_{res} = \frac{V_{span}}{2^N}$$

$$N = \frac{\ln(V_{span}/V_{res})}{\ln(2)}$$