

## STUDY GUIDE FOR EE530 FINAL

The final exam will be **comprehensive** and slightly more heavily emphasize chapters 5-9. This guide lists key important most likely to appear on the exam, but it does not exclude other topics covered or assigned during the semester. Bring a straight edge, clean white paper, SDSU photo ID, calculator, three sheets of notes, and the textbook to the final. (Pages below refer to Analysis & Design of Analog ICs, 4<sup>th</sup> ed.)

### QUALITATIVE KNOWLEDGE

1. Draw or recognize "transistor-pairs" in a larger circuit diagram, such as the 741. Know how they work in the overall circuit.
2. Know BJT, JFET, MOSFET small circuit models and sources of their parasitic components (Chap. 1)
2. Be able to recognize and add different types of feedback to an existing amplifier circuit.
3. Be able to draw the CC stage, CB stage, CE stage with and without emitter resistor, BJT and FET differential amp with resistive loads or active loads. Know qualitatively their ac performance characteristics and probable uses in a larger amplifier circuit.
4. Know qualitatively the basic characteristics (e.g.,  $I_o$  vs.  $I_{ref}$  and  $R_{out}$ ) of different current mirror types.
5. Understand the basic operating principles of BJT and FET and their possible operating modes.
6. Know AC small signal models for BJT and JFET (including their junction capacitors).
7. Know the qualitative differences in gain,  $R_i$ ,  $R_o$ , and bandwidth for basic BJT stages.
8. Understand the sources of mismatches and their effects on diff amp characteristics.
9. Understand the input and output voltage limits for diff amps and output stages.
10. Understand slew rate (versus ac bandwidth) and how to improve slew rate (pp. 680-691).

### QUANTITATIVE AND ANALYTICAL ABILITIES

1. Be able to design a stable DC BIAS CIRCUIT using current mirrors. Be able to analyze the AC characteristics of current mirrors.
2. SINGLE STAGE AMPS: Analyze or design the CC stage, CB stage, CE stage with and without emitter resistor, BJT and FET differential amp with resistive loads or active loads.
3. MULTISTAGE AMPS: Basic DC and AC analyses of the 741 op amp. Understand similarities and differences between BJT and MOS Op Amps in terms of  $R_{in}$ ,  $R_{out}$ ,  $A_v$ , typical operating currents, slew rates, and topology. Be able to calculate ac gain of a simple MOS amplifier (pp. 425-436).
4. OUTPUT STAGES: Understand the output swings and efficiency characteristics of Class A, B, and AB output stages. Able to implement AB stage bias. Know distortion, linearity, power dissipation and efficiency issues.
5. FREQUENCY RESPONSE: Analyze bandwidths (BW) of CC, CB, CE and diff amp stages. Be able to appropriately apply Miller's theorem for estimating the BW of single and cascaded CE stages. Be able to apply open circuit time constants methodology to estimate a circuit's  $f_H$ . Be able to determine  $f_H$ , phase, gain magnitude, GM & PM when given a transfer function.
6. BODE PLOTS: Able to draw a BODE plot for a specified voltage gain and pole & zero specified values.
7. NEGATIVE FEEDBACK: Know the effects of different feedback topologies on gain, BW, input resistance, and output resistance. Be especially familiar with shunt-shunt and series-shunt FB.

Know the stability criterion and the definitions and applications of phase and gain margin. Able to apply an appropriate level of feedback to achieve the desired PM or GM without compensation (pp. 626-633). Understand the role of frequency compensation and how to apply it to typical amplifier circuits (pp. 633-652). Understand the three types of compensation -- Miller compensation & pole splitting, adding a dominant pole, and pole-zero cancellation.

8. DC BALANCING OF INPUT STAGE: Be able to identify and rectify sources of imbalance of in BJT input stage through varying levels of complexity. See Brown & Szeto's papers (1994 & 2000) on this topic.