Multiple Choice

1. Which of the following is not true about parasitic capacitances in a transistor?
   a) they limit the high frequency performance of circuits that make use of the transistor
   b) they are intentionally included in the transistor to enhance the stability of the device
   c) they are partly a result of how the device is packaged
   d) for BJTs they are most often associated with pn junctions in the device

2. Our low frequency analysis of single-stage amplifiers made a few assumptions, intended to simplify the problem. Which of the following is a valid assumption?
   a) the effect of each capacitor can be analyzed in terms of a time constant formed by the capacitor in conjunction with a Thevenin equivalent resistance (across the capacitor)
   b) if the corner frequencies introduced by the various capacitors are separated by a decade or more in frequency, we can analyze the effects of each of the capacitors separately
   c) those capacitors not included in the analysis are replaced with short circuits
   d) all of the above

3. In analyzing a 3-stage amplifier, the appropriate quantity to use as the source impedance of the second stage is:
   a) the output impedance of the third stage
   b) the input impedance of the third stage
   c) the source impedance of the first stage
   d) the output impedance of the first stage

4. Which is the best ordering of filter types with respect to group delay performance (from best to worst)?
   a) Bessel, Chebyshev, Butterworth
   b) Chebyshev, Bessel, Butterworth
   c) Bessel, Butterworth, Chebyshev
   d) Butterworth, Bessel, Chebyshev

5. Which of the following is indicative of instability in a feedback amplifier?
   a) negative phase margin
   b) negative gain margin
   c) a signal output by the amplifier when no signal is input
   d) a condition of positive feedback
   e) all of the above

6. Which is true of the Miller transformation?
   a) at the input it appears that any impedance connected between input and output of a CE amplifier is multiplied, i.e., increased
   b) at the input it appears that any impedance connected between input and output of a CE amplifier is divided, i.e., decreased
   c) it can be used only when a capacitor is connected between the input and output of an amplifier
   d) the effect is substantially greater for a CB stage than for a CE stage
7. When \( f = h_{12} \), the feedback configuration being used is:
   a) series-current
   b) parallel-voltage
   c) parallel-current
   d) series-voltage

8. Two poles, separated by a decade in frequency, will cause the phase to change by ___ for frequencies between the two poles.
   a) 90 deg/decade
   b) 45 deg/decade
   c) 180 deg/decade
   d) 135 deg/decade
   e) 0 deg/decade

9. Introducing a pole at a frequency much less than the other poles (in order to increase stability of an amplifier) is referred to as:
   a) extra pole compensation
   b) pole-zero compensation
   c) dominant pole compensation
   d) pole-zero splitting

10. Which type of switching regulator can provide positive and negative voltages at the output?
    a) Boost regulator
    b) Buck regulator
    c) Buck-boost regulator
    d) all of the above when connected properly

True-False

11) T  F  The integer order filter that comes closest to satisfying the steepness factor requirement for a particular design is the one selected for implementation

12) T  F  For the same order of filter, the Butterworth response provides a quicker transition from passband to stopband than the Chebyshev response

13) T  F  We frequently ignore the full bilateral nature of a feedback amplifier in order to simplify analysis of the amplifier

14) T  F  The type of configuration used for a bandpass section is not critical

15) T  F  A practical Class B amplifier can be made nearly distortionless by adding a crossover removal network consisting of a VBE multiplier circuit

16) T  F  A CE circuit with \( R_c \) and \( R_e \) but with \( R_e \) in parallel with a large capacitor has dc load line with smaller slope than the ac load line

Fill-in-the-blanks

17-21) Five, usually desirable, effects of negative feedback include:

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22-23) An ideal current amplifier has _____ input impedance and _____ output impedance.

24-27) Name the four feedback configurations that were discussed in class.

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28) Find f for the feedback network shown, assuming it is used in a series voltage feedback configuration: _____________

29) Write the two equations that relate h parameters to two-port voltages and currents, given that

\[ h_{11} = \frac{V_1}{I_1} \bigg|_{V_2 = 0}, \ h_{12} = \frac{V_1}{V_2} \bigg|_{I_1 = 0}, \ h_{21} = \frac{I_2}{V_2} \bigg|_{V_2 = 0}, \ h_{22} = \frac{I_2}{I_1} \bigg|_{I_1 = 0} \]

Answers: __________________ and _________________

30) In the general expression \[ A(s) = \frac{a(s)}{1 + fa(s)} \] what happens as an amplifier becomes unstable?

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Short answers

31. Show the midband frequency small-signal model for a CS stage (with source feedback).
32. Show the Bode magnitude and phase plots for a lowpass transfer function with corner frequencies of $\omega$, $10\omega$ and $1000\omega$.

33. Given a transfer function of the form for a lowpass filter

$$T(s) = \frac{1}{s^2 + \sqrt{2}s + 1}$$

with cutoff of 1 rad/sec, what would the transfer function be for the transformed bandpass filter? (Write in the form of a ratio of polynomials)
34. Draw the small-signal model that is used in analyzing the differential-mode performance of a coupled emitter differential amplifier.

35. Determine the transfer function for the simple circuit shown below. Show steps.

36. What two parasitic capacitances have the greatest effect on the high frequency performance of a BJT CE amplifier?

37. Draw the block diagram for a series-current feedback configuration.

38. Give at least two reasons why a resistor is not desireable as the current source for a differential amplifier.

39. Draw the small signal (low-frequency) model for a FET CG amplifier.
40. The following circuit is used for feedback in a series-current configuration. Find the value of $f$ for this circuit.

41. A Class C amplifier has a higher efficiency than any of the other classes of power amplifiers and yet it is not commonly used. Why?

42. What is the purpose of the steepness factor in active filter design?

43. Show the high frequency small-signal model for a CS stage (with source feedback).

44. Many stages are cascaded in a typical op amp. Why are so many stages needed?

45. How does an active current source improve CMRR performance of a differential amplifier stage?