Subjects for Theory "Fundamental Electronic Circuits"

1. N-channel MOSFET biasing (the arrangement with 3 resistors, single supply and the arrangement with current source, single / differential supply; for each arrangement: circuit, relations for voltages and currents).
2. Npn BJT biasing (the arrangement with 4 resistors: circuit, relations for voltages and currents in the case of precise calculation and in the case of approximate calculation neglecting the base current, stability conditions for the operating point).
3. Common source (CS) amplifier (complete circuit, small-signal equivalent circuit, determination of voltage gain, input and output resistances).
4. Common emitter (CE) amplifier (complete circuit, small-signal equivalent circuit, determination of voltage gain, input and output resistances).
5. MOSFET current sources and current mirrors (current source and current sink: circuits, expression of the current, condition to avoid the linear (extreme conduction) region; current mirrors: expression of the mirrored current for identical transistors and for different W/L ratios).
6. Feedback circuits (the general structure of the feedback circuit, transmittances; NF and PF circuit structures, determination of the equation for ideal negative feedback).
7. Negative feedback effects on amplifiers (effect on the gain; effect on bandwidth for low-pass-type amplifier, gain bandwidth product; effect on the input and output impedances: relations for all four topologies.
8. Op-amp positive voltage regulators ($V_O > V_{REF}$; $V_O < V_{REF}$; adjustable V_O, $V_{O\max} > V_{REF}$ $V_{O\min} < V_{REF}$; for each circuit: the schematic and the expressions of V_O).
9. Overcurrent and shortcircuit protection for dc voltage regulators (circuit; the relation of the maximum output current; explanation of the limitation mechanism; the output characteristic of the regulator, with explanation of the characteristic regions).
10. The sinusoidal oscillator structure and the oscillation criterion (the structure of a positive feedback sinusoidal oscillator; Barkhausen criterion; module condition, phase condition and their utilization).
11. Automatic control of the amplitude using diodes for the Wien bridge oscillator (circuit, relations of the gain in the start up phase and in the limitation of the amplitude phase, explanation of the automatic gain control mechanism).
12. Astable multivibrator – rectangular signal generator (circuit; waveforms of the output voltage and of the voltage across the capacitor; extremes values of the voltage across the capacitor; the deduction of the oscillation period and frequency).
13. Rectangular and triangular signal generator - astable multivibrator with an integrator and a PF comparator (circuit; waveforms of the rectangular and triangular voltages; extremes values of the voltage across the capacitor; the deduction of the oscillation period and frequency).
14. Class B power amplifier (circuit; analysis of the operation; VTC; waveforms for input and output voltages highlighting crossover distortions; waveforms for output voltage, waveforms for collector current and collector-emitter voltage for the npn transistor, assuming a sinusoidal regime with maximum amplitude of the output voltage).
15. Powers and efficiency for a class B power amplifier assuming a sinusoidal regime (circuit, average supply power, average output power, average efficiency, conditions for maximum average efficiency, maximum average efficiency, considering the conditions for maximum average efficiency).
16. Class D power amplifier (block diagram; operation principle; PWM generator: basic circuit, waveforms for input sinusoidal voltage, triangular voltage, and output voltage; power stage: basic circuit; low-pass filter: circuit).
17. Noninverting op-amp amplifier operated from a single power supply (full circuit, derivation of the output voltage, illustration of the circuit operation by waveforms – input voltage, total voltage to the noninverting op-amp input, total output voltage)
18. Op-amp integrator and differentiator circuits (circuits; the deduction of the output voltage expressions in the time domain).
19. Precision half-wave and full-wave rectifiers (circuits, operation, illustration of the operation using waveforms).

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