

Typical PhD Screening Exam Topics: Electronics

Superposition, source transformations, Thevenin and Norton Equivalents, high-pass and low pass filters.

Principles of inductors and capacitors, First-order RC circuit ODE solutions, First-order RL circuit ODE solutions

Operational Amplifiers, Equivalent circuit, Virtual short principle, Basic configuration analysis: follower, inverting, non-inverting, summer, instrumentation, ideal operational amplifiers characteristics and applications. Integrated circuit OPAMP applications; analysis and design of non-ideal OPAMPs. Concepts of negative and positive feedback.

Laplace Transformation, definition of unilateral and bilateral, application to basic signal waveforms, Properties: linearity, differentiation, integration, shifting, periodicity, partial fraction expansion, real roots, repeated real roots, complex roots, Solving differential equations, Linear system terminology: zero-state response, zero-input response, total response, transfer function, natural response, forced response, steady-state response, impulse response, step response

Applications of the Laplace Transform, Complex Impedance, Initial Value Theorem, Final Value Theorem, Sinusoidal Steady-State Response, Frequency Response, Network Theorems in the s-domain, Circuits with initial energy storage, Switched capacitor networks, Phasor Analysis, Definition Network theorems, Single-Phase and Three-Phase Power, Transformers, Electric Machines - DC, Induction, Synchronous

Solid state physics and semiconductor fundamentals; electron & hole doping, electrical characteristics. Conductivity, drift, diffusion related to P-N junction operation to define the diode's electrical characteristics. Diode circuit applications; circuit models and applications to clipping and rectification; simple dc power supplies.

Bipolar junction transistor operation modes, transconductance, output resistance, characteristics and modeling. Transistor applications as amplifier; nonlinear operation as a switch; cutoff and saturation. BJT amplifier frequency response characteristics and design considerations. BJT digital applications TTL and ECL logic families.

FET characteristics, transconductance, threshold voltages, MOSFETs and MESFET characteristics, modeling and applications. MOS amplifier frequency response characteristics and design considerations. Applications of FET, MOS, and CMOS IC biasing and logic circuits.

Basic BJT and MOS differential amplifiers configured as multistage amplifiers. Small and large signal analysis of CE, CC, CB and CD, CS and CG amplifiers.

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Note: This list is provided only as a guideline to the student and may not be completely comprehensive. Examiners reserve the right to determine specific areas of concentration, and students may be examined on any topic that broadly relates to the area.