

Question to study, part I.

1. Concept of one-port (two-pole) and two-port.
2. Concept of transfer function of a time-invariant electrical system.  
Definition and properties of a linear transfer function. Example of linear components.  
Definition and properties of a nonlinear transfer function. Examples of nonlinear components. Examples of distortion caused by nonlinear transfer functions.
3. Describe the method of superposition. In what kind of systems can we use it?
4. Analog signals, discrete, quantized and digital signals. Quantization error.
5. Concept of sampling and reconstruction. Sampling theorem (Nyquist–Shannon sampling theorem).
6. Basic concept of Fourier-series and transformation and spectrum. Its uses in electrical engineering.
7. Formula of a time-domain voltage sinewave, describe the quantities.
8. Concept and calculation of decibels for power and voltage.
9. Concept of transient effects (time-dependant effects, such as at turning on or off circuits).  
Common probing signals: step function  $\epsilon(t)$ ; Dirac-impulse  $\delta(t)$  or its approximation as a short impulse (waveform graphs)
10. Describe the structure and operation of capacitors. Relationship of capacitance, charge and voltage.
11. Time-domain function (waveform) of an RC circuit's output ( $V_C$ ) if the input is a step function (ie. charging waveform of a capacitor). Discharging waveform of a capacitor. Define the time constant.
12. Describe structure and operation of inductors (coils).
13. Time-domain function (waveform) of an RL circuit's output ( $V_L$ ) if the input is a step function (ie. magnetization). Also demagnetization waveform. Define the time constant.
14. Describe structure and operation of transformers and write their equations.
15. Frequency response plots of systems (Bode-plots). Concept and basic types of filters (low-pass, high-pass, band-pass, band-stop) and their Bode-plots.
16. Symbol, structure and operation of semiconductor PN-junction Si diodes. Characteristic I-V graphs. Main parameters.
17. Half-wave (one-way) rectifier circuit, output waveform (with sine input) with and without buffer capacitor.
18. Full-wave (two-way) rectifier circuit with center-tap transformer. Output waveform (with sine input) with and without buffer capacitor.
19. Full-wave (two-way) rectifier circuit, Graetz-type. Output waveform (with sine input) with and without buffer capacitor.
20. Operation and graph of Zener-diodes. Simple voltage stabilizer (R+Zener).
21. Voltage limiters with diodes and Zener-diodes.
22. Light-emitting diodes operation and main attributes, spectrum.
23. Photodiodes operation and characteristics (I-V with regard to different input optical power). Photovoltaic cells.
24. Simplified structure, symbol, V-I graphs, main properties and equations of bipolar transistors. Their main applications.
25. Simplified structure, symbol, V-I graphs, main properties and equations of enhancement mode MOSFETs. Their main applications.