No materials, no calculator. Prepared by M. Valkama.

NB 1: Pay special attention to clear handwriting. If I cannot read your text with reasonable effort, your paper cannot be unfortunately graded. So, please, try to write your responses and solutions in a clear manner. Much appreciated. Thanks very much. Danke schön. Muchas gracias.

NB 2: You are allowed to return only 1 response sheet that is distributed once we start. You can certainly write to all 4 individual sides of the response sheet. Also, extra sheets are available for possible intermediate/personal notes, but only one sheet can be returned and graded.

Thank you. Enjoy. ☺

1.   Explain shortly the following concepts in the context of electrical/electromagnetic communications:
      a) spectrum, b) transfer function, c) amplitude distortion, d) nonlinear distortion, e) correlation.

      No need to dwell on all possible finest details, basic explanations which show your understanding are basically enough.   (5p)

2.   Explain the concepts of thermal noise, white noise and Gaussian noise. Explain also how the observable thermal noise power is calculated and how does it depend on the observation/receiver bandwidth.   (4p)

3.   Explain the concepts of I/Q modulation and I/Q demodulation, in general. Illustrate the principles by drawing appropriate block-diagrams and some example spectral contents of relevant signals in different stages. Explain also how I/Q modulation principle utilizes the general bandpass signal characteristics. Finally, explain shortly how the CW modulation concepts of amplitude modulation (AM), dual-sideband modulation (DSB), and phase modulation (PM) utilize the degrees of freedom available in bandpass signals ?   (6p)

Maximum points: 5 + 4 + 6 = 15p