INFORMATION TECHNOLOGY

general subject (final exam topics, Information Technology specialization)

1. Spatial and pixel level transformations in digital images: Mirror, shift, rotate, negative, gamma-correction, contrast-stretching, clipping, thresholding, Look-Up Table, histogram, cumulative histogram, histogram-based transformations, brightness, contrast, histogram equalization.
2. Local image processing techniques: Kernels, convolution, boundary conditions, low-pass filters (smoothing), high-pass filters (edge detection, edge enhancements), Prewitt, Sobel, Laplace, Canny edge detection, rank filters.
3. Morphological Image Processing: Structuring elements (templates), shape of structuring elements, neighbourhood definitions and connectivity, transformations, erosion, dilation, opening, closing, hit-and-miss, thinning, thickening, applications.
4. Fourier transforms of digital images: meaning of the Fourier transform of an image, different frequency representations (position of low and high frequencies in the image), amplitude- and phase-information, realizations of low-pass and high-pass filters, advantages, disadvantages, application areas.
5. Describe the architecture of PLA devices, show and discuss its schematic diagram. Give an example for synthesizing a minterm list on PLA architecture. Describe the PAL devices and present an example design with them using a minterm list.
6. Describe the main architectural drawbacks of the PLA and PAL devices. Describe the GAL and CPLD devices. Talk about the importance and structural elements of the macro cell. Tell about the main fields of use of GAL and CPLD devices and the reason behind their disadvantages.
7. Talk about the architecture of FPGAs. Describe the input/output banks, combinational logic blocks, and the purpose and importance of switch matrices.
8. Talk about hardware description languages. Describe them in detail stating their main properties and area of use. Discuss the role of hardware description languages in the modern digital design flow.
9. Describe the traditional and modern digital design flows. Talk about the main differences between and what is the purpose of hardware description languages in the modern design flow.
10. Describe the characteristics of digital signal processors: Harvard architecture, the MAC instruction. Compare the analog and digital signal processing, describe the sampling steps: sampling frequency selection, quantization error, filtering, the effect of subsampling. Give some application examples.
11. Describe the typical filter types: Analog filter types and their characteristics. Importance of linear phase response. Digital Fir filter topology, pulse response, phase response, filter parameters. Structure and characteristics of the IIR filter. Describe some application examples.
12. Describe the types and characteristics of the Fourier transform: Fourier series, Fourier transform, Discrete-time Fourier transform, Discrete Fourier, transform. Describe the algorithm of the fast Fourier transform. Provide some application examples.

The examination subject consists of the curriculums of the following subjects:

- TTFBE1311 Programmable Logic Devices,
- TTFBE1313 Technical Image Processing,
- TTFBE1316 Digital Signal Processing.

NANOTECHNOLOGY

specialized subject (final exam topics, Information Technology specialization)

1. Size-dependent parameters of an electronic material. Size reduction problems in electronics.
2. Top-down methods.
3. Bottom-up methods.
4. Production of thin films by PVD methods: types, advantages, disadvantages, application possibilities.
5. Production of thin films by CVD methods: types, advantages, disadvantages, application possibilities.
6. Investigation of the properties of thin films using electrons.
7. Investigation of the properties of thin films using X-rays.
8. Laser diodes: structure, principle of operation, materials and important parameters.
9. Nanostructured memory elements.
10. Carbon nanostructures: types, structure, properties and applications.
11. Technology, parameters and applicability of plasmonic elements.
12. Electrical properties of nanosized materials.
13. Optical properties of nanoscale materials.
14. Nanocomposites: structures, materials, properties.
15. Types, technology and application of optical fibers in telecommunications.
16. Optical windows, filters: types, materials, parameters, applications.
17. Light sources: types, materials, parameters, applications.
18. Light sensors: types, materials, parameters, applications.
19. Solar panels: types, materials, parameters, applications.
20. Trends in Microelectronics and Technology, Moore's Law.

The examination subject consists of the curriculums of the following subjects:

- TTFBE1314 Nanoelectronics and Nanotechnology,
- TTFBE1315 Photonics.