Basic thematic areas for the Final State Examinations

Follow-up Master's degree program in Textile Engineering

Specialization: NONWOVENS AND NANOFIBROUS MATERIALS

AREA: TEXTILE MATERIALS **(contains questions from the subjects Properties of Fibres, Textile Chemistry and Textile Engineering)**	
1	Tensile curve, description, and basic formulas. (strength, ductility, elasticity)
2	Determination of polymer density, use in identification and analysis of fibers.
3	Stress and creep relaxation, basic equations and graphs.
4	Methods of analysis of internal structure and arrangement of polymers.
5	Static electricity generation, ways to limit static electricity generation.
6	Models of viscoelastic fiber behavior, including the Maxwell and Voight model, basic equations, and model conception
7	Geometric description of fibers (fineness, shape factor…), basic relations.
8	Methods of thermal analysis of polymers, principles, application, transition temperatures of semicrystalline polymers.
9	Dynamic-mechanical analysis of fibers, method, application.
10	Polymers - basic concepts, properties, crystallinity, chemical composition
11	Synthetic polymers and their preparation, properties of selected synthetic fibers.
12	Fibers from natural polymers, damage detection, chemical nature, regenerated cellulose fibers
13	Surfactants, properties and uses.
14	Textile finishing, pretreatment, cotton pretreatment processes.

15	Textile dyeing - basic concepts and principles, dyes and pigments.
16	Textile printing - basic principles, digital printing.
17	Final finishing of fibers - principles of selected final finishing (e.g., hydrophobic, non-flammable)
18	Fiber blending - reasons, complications in refining, analysis of fiber blends, bicomponent fibers.
19	Ecological aspects and recycling of textiles - key problems, recycling procedures, color fastness and durability of textiles.
20	Fibers (What is the difference between staple fiber and a filament? What are the characteristics of wool and polyester?)
21	Spinning (What is the basic difference between staple spun yarns and continuous filament yarns? What are the different methods of spinning?)
22	Weaving (Description of two sets of yarns present in woven fabrics? Which shedding mechanism we are able use for weaving?)
23	Knitting (What are weft knitted structures? What are the parts of a needle?).
24	Finishing (How do you evaluate wash fastness? What processes can be used in pretreatment of cotton?)
25	Nonwoven (What are the raw materials used for the production of nonwovens? What are the properties of spun bond nonwoven?)
26	Clothing (What is the purpose of a guide? What is a shuttle in a sewing machine?)

AREA: FIBER STRUCTURES AND THEIR EVALUATION **(contains questions from subjects Structure of Fibrous Assemblies, Special Measurement Methods and Statistics)**	
1	Basic parameters describing yarn. Helical yarn model, definition, assumptions.

2	Tensile stress and yarn strength provided the ideal helical model. Relative elongation of the twisted bundle of fibers. The dependence of the strength is due to its twist.
3	Basic parameters of surface geometry of fabric, definition of limit delivery of threads in fabric.
4	Basic parameters of spatial geometry, model of fabric geometry in cross section, Peirce's model of fabric, assumptions, fabric thickness.
5	Fabric mechanics using Peirce's model - non-deformable yarns (fabric elongation in two main directions, Poisson's ratio), - deformable yarns (fabric strength in two main directions), explanation of main principles.
6	Fabric mechanics - deformation of the thread at the binding point, Kemp's cross section
7	Model of the geometry of the knitted fabric - covering, model shape of the loop, relative length of the thread in the loop, limiting densities.
8	Mechanics of knitwear - tensioning of knitwear in two main directions - basic ideas, non-deformable x deformable yarns (parameter of reduction of effective diameter of yarn), strength of knitted fabric in the direction of row, columns.
9	Modeling of fiber orientation in the plane - the principle of the substitution model of the elastic band with spikes, the resulting probability density at isotropic and anisotropic orientation in the plane. The principle of determining the orientation of fibers in the section.
10	Multiaxial fabrics - mechanical behavior - geometry and forces in one thread, one system and in the whole multiaxial fabric (only the simplest solution with small deformations, linear tensile curve), the resulting relations for regular multiaxial fabrics.
11	Relationship between metrology, standardization and testing. Standards, traceability schemes, conditions for accurate experimental work. Basics of

	estimation of measurement uncertainties.

12	Electromagnetic radiation I - basic concepts, radiation of an absolutely black body, light sources, light transmission through substances - scattering, right absorption, luminescence, fluorimetry, evaluation of visibility in daylight in garments with high visibility.
13	Electromagnetic radiation II - optical activity, dichroism, polarimetry, interferometry, evaluation of retroreflection and visibility in high visibility clothing.
14	Microscopy I - theory of imaging and construction of light microscope, magnification calculation, resolution and numerical aperture, EPI and DIA illumination, polarization microscopy, phase contrast, phase contrast, Nomarski differential interference contrast, Hoffman modulation contrast.
15	Microscopy II - confocal microscopy, multiphoton confocal microscopy, confocal microscopy in materials engineering, microscopic measurements, electron microscopy, scanning probe microscopy. Optical measuring methods 2D and 3D.
16	Basic colorimetry I - basic concepts, lighting, lighting sources. Instrumentation - spectrophotometers, colorimeters and gonio spectrophotometers. Contactless measurement techniques, multispectral image analysis.
17	Basic colorimetry II - colorimetric systems CIE XYZ, CIELUV and UCS - approximately uniform colorimetric systems.
18	Electrical properties of materials - conductivity theory, basic principles of measuring electrical and dielectric properties of materials.
19	Thermal properties of materials - basic thermodynamic concepts, methods of measuring thermal thermodynamic properties of materials.
20	Digital image - creation, scanning, representation. Basic steps in image processing. Sampling and quantization. Basic types of images. Mathematical tools used in image processing. Basic relationships between pixels (neighborhood, connectivity, area, boundaries, distance measures).
21	Brightness transformations. Basic transformation functions. Histogram equalization.

22	Basics of image filtering in the spatial area. Spatial correlation and convolution. Smoothing. Smoothing linear spatial filters. Smoothing nonlinear spatial filters.
23	Descriptive statistics - data types, graphical procedures for data display (histogram, pie chart, boxplot, variance diagram, etc.), position characteristics (mean, median, mode, quantile), variability characteristics (variance, standard deviation, coefficient of variation, range, interquartile range ...)
24	Probability - Random variable and its characteristics: distribution function, mean, median, quantiles, mode, density, probability function.
25	Examples of the most important random variables with discrete and absolutely continuous distributions: alternative, binomial, Poisson, geometric, hypergeometric, uniform, exponential, normal distributions.
26	Basic concepts of mathematical statistics: random selection, parameter estimates - point and interval estimation (confidence interval) for the mean, variance and parameter of binomial distribution, the principle of hypothesis testing, the error of the first and second kind, test level, t-tests, Wilcoxon test, analysis of variance.
27	Correlation analysis: Pearson's correlation coefficient, Spearman's correlation coefficient, correlation coefficient test.
28	Regression analysis Linear regression - model, principle and method of estimation (least squares method), tests in linear regression.

AREA: NONWOVENS AND NANOFIBRE MATERIALS **(contains questions from subjects Theory of Nonwovens, Industrial Textiles, Mechanical Technologies of Nonwovens, Thermal and Chemical Technologies, Physical Principles of Electrospinning and Polymer Physics)**	
1	Harkinson's coefficient in the description of materials, super-wetting and super-non-wetting surfaces.
2	Conditions of perfect wetting of a single fiber and the bundle of fibers.
3	Plateau-Rayleigh instability.

4	Lucas-Washburn relationship - dynamics of penetration of liquids into a cylindrical capillary.
5	Methods for measurement of contact angle.
6	Define the term hydraulic gradient and explain its application in measuring the permeability of a liquid in the plane of a fabric.
7	Procedures for determining the actual fabric cross-section for tension determination.
8	Determination of pore size by bubble method. Calculation procedure.
9	Determination of basic filter characteristics (D'Arcy equation, efficiency, pressure drop).
10	Rheological models of composites (determination of Young's moduli of individual components and their combinations).
11	Procedures for the production of fibrous layers from staple fibers.
12	Describe the "Airlaid" technology, the properties of the layers, the processed materials, their properties and applications. Define the technology's advantages and disadvantages.
13	Describe the wet-laid process of nonwoven fabric production (raw materials, principle, machine diagram). Specify areas of use.
14	Application of "Spunlace" technology. Describe water treatment, machine diagram, patterning options and product examples.
15	Principles of recycling and reuse of textile materials.
16	Draw a diagram of the needle-punching machine and a needle. Process parameters and their effect on the product properties.
17	Thermal properties of polymers – Tg, Tm, specific heat, dependence of Tg and Tm on structure, effect of copolymerization, temperature dependence of mechanical properties, glass, viscoelastic and viscous state, crystallinity, its kinetics and determination methods.

18	Methods of binders application to fibrous layers. Describe the types of bonding sites.
19	Forms of binders used for nonwovens (solutions, dispersions, foams, bico fibers, powders, grids, foils). Adhesion.
20	Describe Spunbond technology (used polymers, fiber diameters, the principle of fiber layer formation, properties of fiber layers, final products, and their use.
21	Describe the Meltblown technology (used polymers, fiber diameters, principle of fiber layer formation, properties of fiber layers, final products and their use.
22	Energy states during electrospinning. What is potential (ability to do work). The effect of electric forces on polymeric solution, deformation of liquid surface (Taylor cone).
23	Electric field during electrospinning. What is an electric field, how do we represent and describe it. Electric field intensity, unit, homogeneous electric field and inhomogeneous electric field.
24	Electrospinning technology for the production of nanofibers. The principle of the technology, its execution, and process parameters of spinning. DC and AC spinning. Comparison of principles and differences and application of the obtained fibers.
25	The possibilities of creation of nanofibers by other means than electrically. Centrifugal spinning (force spinning) - design, equipment, and process parameters. Drawing of individual fibers - design, equipment, and process parameters.
26	Interaction of polymer chain with solvent.
27	Mechanical properties of polymers – tensile curves, relaxation, creep, viscoelastic properties and description using models, rubbery state, elastomers.
28	Viscosity - definition, dependence on mol. weights, temperatures and shear rates, Newtonian and non-Newtonian behavior, thixotropy and rheopexy, methods of measurement.
29	Solubility of polymers and properties of solutions. Solubility parameters, dependence of viscosity on concentration of solutions, solvents for selected polymers.