**Production system management**

**1. Production**

1. Production system (description)
2. Types of production according to the consumption of production (point of disconnection of orders), according to the nature of the production process and according to the continuity of the production process
3. Competitiveness factors

**2. Production process**

1. Definition and division of business processes
2. Technological and working process
3. Standardization of company processes (content and code lists, technical standardization, technical and economic standards)

**3. Management process**

1. Management process as information effect, phases and cycle of management process
2. Elements, approaches and methods of the decision-making process
3. Production management system from the point of view of internal and external connections.

**4. Production capacity, production task, production consumption and stocks**

1. Definitions (production capacity, production task, production consumption, production stocks)
2. Analysis of production capacity indicators (performance or rhythm and measure, time pool, labour) and production task (required performance, production rhythm and measure)
3. Analysis of production consumption indicators (types and methods of standardization) and stocks (types and size of stocks - calculation: minimum, maximum, average and current stocks)

**5. Spatial structure of the production process**

1. Content and objectives
2. Ways of arranging workplaces
3. Methods of optimization of spatial structure (objects in space and workplaces within objects)

**6. Time structure of the production process**

1. Lead time of product and production
2. Ways of shortening the continuous production time (laborious operations and number of simultaneously processed parts, number of parallel workplaces and workers, technical level, number and use of machines, mutual overlap and simultaneous execution of work operations, size of production batches, application of SMED principles, setting of production advance, solution of inventories of work in progress)
3. Time utilization of workers and machinery and production equipment (standardization of workers' time consumption, time utilization and consumption of working time of machines and equipment)

**7. Forms of organization of operational activities and production lines**

1. Forms of organization of operational activities from the point of view of relations and continuity of workplaces
2. Definition and typology of production lines (according to connection and structure)
3. Capacity calculations of production lines (rhythm, cycle, content of intermediate storage, number of employees, number of elements in cells)

**8. Data and its properties**

1. Raster and vector data
2. Data resolution (radiometric, spectral, spatial and temporal)
3. Basic ways of visualization (panchromatic image, color synthesis, pseudocolor image)

**9. Production and workers**

1. Factors affecting the increase of employee performance (flexibility, continuous training, motivation, workplace layout, work and rest regime in relation to employee performance during age, shift, week), parameters of the working environment
2. Working studies of time, movement and force
3. Principles of the KAIZEN and 5S system

**10. Designing the structure of production**

1. Types of innovations and innovation cycle, marketing and sales plan
2. Methods of optimization of production structure
3. Methods and tools used in the application of the TOC method (finding and removing bottlenecks and side effects in production; methods of implementing changes)

**11. Spectral properties**

1. Factors affecting EMR radiation, spectral reflectance and behaviour
2. Spectral response of vegetation and soil
3. Spectral indices (basic vegetation indices, categories)

**12. Operational planning**

1. Operational sales planning (tasks, sales activities, distribution channels)
2. Operational production planning or provision of services (main production plan, capacity plan and schedule, time plan and schedule, chart, standard methods of operational production planning for different types of production according to continuity)
3. Operational supply and purchasing planning (tasks, purchasing marketing, operational supply planning procedure, dependence / independence on production outputs, replenishment systems)

**13. Operational records, change management and technical preparation of production**

1. Content and tasks of operational records of production or provision of services
2. Content and tasks of change and deviation management
3. Content and tasks of technical preparation of production and its connection to operational management of production processes

**14. Aerial remote sensing**

1. Concepts of aerial photography (cameras, format, overlaps, filters)
2. Principles of photographic interpretation (contrast, feature, shape, shadow, location and association, orthophoto projection)
3. Unmanned Aerial Vehicles data

**15. Satellite systems**

1. Overview of current satellite systems
2. Program Copernicus (Sentinel 1, 2, 3) – description of systems, spatial and spectral resolution, SW products
3. Landsat program (overview, sensors)

**Agricultural engineering**

**Conceptual arrangement and design of main groups of vehicles**

1. tractors
2. cars
3. trailers

**2. Accessories for internal combustion engines**

1. fuel system of compression diesel and spark ignition engines
2. lubrication system, oil purification
3. cooling system, engine temperature control

**3. Transmissions of tractors and means of transport**

1. couplings - division, functional properties
2. gearboxes - mechanical and hydraulic
3. gearboxes and differentials

**4. Chassis parts of tractors and means of transport**

1. driving wheeled and crawler vehicles
2. brakes - fluid and air
3. wheels, crawler travel mechanism

**5. Hydraulics of tractors and PTO shafts**

1. internal hydraulic circuit, regulation
2. external hydraulic circuit
3. distribution and use of PTO shafts

**6. Electrical and electronic equipment of tractors and vehicles**

1. sources of electrical power on the vehicle
2. electrical appliances of the vehicle
3. electronic devices increasing the safety, economy and ecology of operation

**7. Machines for soil tillage and cultivation**

1. share plows and disc tools
2. machines with driven working tools
3. cultivators, hoeing machines and combination machinery

**8. Sowing and planting machines**

1. sowing methods, quality of sowing and planting
2. seed drills, principles and quality of work
3. planting machines for potatoes, principles

**9. Fertilizing machines**

1. methods of fertilizer application, spreading quality
2. organic fertilizer spreaders, specific dose control
3. mineral fertilizer spreaders, distribution, uneven application

**10. Machines for plant protection**

1. plant protection methods and quality of application
2. sprayers and mistblowers, functional elements
3. nozzles, division and description

**11. Mowers**

1. machines with reciprocating movement of knives
2. machines with rotary movement of knives
3. division of individual groups, advantages and disadvantages, used machines.

**12. Forage harvesters, collection trucks and collection presses**

1. selection of a suitable machine
2. forage harvesters, division, construction, technological process, suitability use
3. presses for pressing prismatic and cylindrical bales, suitability for use, advantages and disadvantages

 **13. Combine harvesters**

1. selection of a suitable combine harvester
2. the effect of the threshing system, shaker and cleaner on the quality of work
3. grain losses, their indications and possibilities for reduction
4. electronic systems, yield meters, loss meters, precision agriculture

**14. Machines for harvesting technical crops, fruits and vegetables**

1. harvesting technology
2. techniques for harvesting and post-harvest treatment of hops
3. machines for harvesting broom vegetables, tree fruits and grapes

**15. Machines for harvesting root crops**

1. problems of harvesting in terms of mechanization, harvesting methods, harvest losses
2. the procedure in the potato harvester and the function of the various mechanisms
3. cutting and plowing mechanisms of tubers, cleaning and transport of tubers, assessment of quality of work

**16. Processing of agricultural materials for feed purposes**

1. shredding, squeezing, cutting, cleaning, grinding, steaming
2. silage
3. mixing, shaping

**17. Technique and technological systems in cattle breeding**

1. mobile feeding lines
2. stationary lines of feeding, watering
3. removal of manure and liquid faeces

**18. Technique and technological systems for milking**

1. standing milking in cans
2. standing milking in pipes and milking parlors
3. basic milk treatment on the agricultural holding

**19. Technique and technological systems in poultry farming**

1. the hatcheries and the hatching process of the chickens
2. the feeding of poultry in floor and cage farms
3. watering of poultry and removal of excrement in floor and cage farms

**20. Technique and technological systems in pig breeding**

1. dry and wet feed technology
2. liquid feed feeding technology, feeding methods
3. the stable environment and the ways of its securing

**Biosystems Engineering**

**1. Atomic structure**

1. Protons, neutrons and electrons
2. Hund’s rule in electron configuration of elements
3. Bound electrons, Free electrons and Electric field

**2. Speed, velocity and acceleration**

1. Vector and scalar quantities
2. Constant velocity
3. Uniform acceleration and non-uniform acceleration

**3. Energy, mechanics and heat**

1. Potential energy and Kinetic energy
2. Principle of energy conservation?
3. Mechanical advantage

**4. Fundamental properties of vectors**

1. Parallelogram law and Triangle law
2. Commutative property, associative property, distributive property
3. Dot (scalar) product of vectors and Angle between two vectors

**5. Fundamental concepts and principles in mechanics**

1. Basic concepts and Fundamental principles in Mechanics
2. Newton’s three laws of motion
3. Force and characteristics of a Force

**6. Elasticity**

1. Hooke’s law
2. Young’s Modulus
3. Tensile stress and tensile strain

**7. Electric and magnetic fields**

1. Conductors and insulators
2. Coulomb’s law
3. Relative permittivity

**8. Moisture content and porosity**

* 1. Relationship between dry basis and wet basis
	2. Determination of moisture content
	3. Determination of porosity

**9. Sustainable agriculture**

* 1. Sustainable agriculture development
	2. Deforestation
	3. Soil nutrient, soil erosion and soil fertility

**10. Storage, packaging and transportation of products**

* 1. Cold supply chain management
	2. Storage and packaging
	3. Postharvest losses

**11. Physical and mechanical properties**

* 1. Physical and mechanical properties of agricultural materials
	2. Factors influencing mechanical properties of agricultural materials
	3. Smooth curve and serration effect

**12. Oil extraction methods**

* 1. Oil extraction methods
	2. Linear compression process
	3. Effects of temperature and moisture content on oil recovery efficiency

**13. Design of experiment and analysis**

* 1. Experimental design
	2. ANOVA analysis and regression analysis
	3. Evaluation of statistical significance of experimental data

**14. Drying and drying curves**

* 1. Drying of agricultural products
	2. Drying process
	3. Drying curve of agricultural product

**15. Bioseparation processes**

1. Importance of bioseparation processes
2. Stages of bioseparation process
3. Unit operations in bioseparation