**Basic Physical Sciences**

**1. Structure of agromaterials**

1. Structural units, types
2. Dispersion – Dimension
3. Texture, Density, Moisture Content

**2. Elasticity and Inelasticity of agroproducts**

1. Degree of Elasticity, Hysteresis Losses,
2. Modulus of Elasticity (Young’s, Shear, Bulk)
3. Stress relaxation, Creep, Role of temperature and deformation rate

**3. Thermal Properties**

1. Thermal Capacity, Thermal Conductivity, Thermal Diffusivity,
2. Role of the composition, mainly of Moisture Content
3. Sorption Phenomena, Viscosity

**4. Electromagnetic Properties**

1. Electric Conductivity and Permittivity,
2. Role of frequency and composition,
3. Light and Colour,
4. Vegetative Index, Index of Maturity

**5. Mechanics–basic theory of 2D statics**

1. 2D - Equilibrium of two and three forces
2. 2D – Area system with central point of action
3. 2D – General area system

**6. Mechanics – 2D statics**

1. Binary member
2. Bar construction
3. Real supports

**7. Mechanics of materials – tension, compression, shear**

1. Deformation and strength condition for tension and compression
2. Hooke’s law, deformation diagram
3. Strength condition for shear

**8. Mechanics of materials – torsion, bending**

1. Deformation and strength condition for torsion
2. Steiner’s postulate, section modulus for bending
3. Shearing force diagram, bending diagram

**9. AC and DC voltage sources**

1. Parameters of the DC currents
2. Parameters of the AC currents
3. Electric power
4. R, L, C parameters

**10. Basic semiconductor device**

1. Diodes
2. Thyristors
3. Transistors
4. Basic characteristics

**11. Three-phase voltages**

1. Line to neutral voltage
2. Line to line voltage
3. Powers and their definition
4. Mean and rms values

**12. Induction motors**

1. Construction
2. Losses
3. Torque-speed characteristic
4. Utilization in practice

**13. Properties and applications of structural materials**

1. Structural steels (types, identification mark of steels, mechanical and chemical properties, application)
2. Cast irons (types, identification mark of cast irons, mechanical and chemical properties, application)
3. Non-ferrous metals and alloys (types, mechanical and chemical properties, application)

**14. Testing of mechanical properties of materials**

1. Tensile strength of steels, testing equipment, diagram force – elongation, toughness, contraction
2. Impact toughness, testing equipment
3. Hardness. Methods of hardness testing

**15. Heat treatment of steels**

1. Annealing
2. Hardening and tempering
3. Thermochemical treatment

**16. Polymeric materials and composites**

1. Thermoplastics. Types, properties in comparison with metals, application
2. Thermosets. Technology of production. Properties
3. Composites. Matrix and reinforcement

**Agricultural Engineering**

**1. Sorting and conception of motor vehicles**

1. Tractors
2. Cars, commercial vehicles
3. Trailers, semitrailers

**2. Engine and engine accessories**

1. Spark and ignition combustion engines
2. Fuels and fuel systems
3. Lubricants and lubrication

**3. Transmission of motor vehicles**

1. Clutch, gearbox
2. Differential, final drive, P.T.O.
3. Hydrostatic and hydrodynamic transmission

**4. Chassis and body**

1. Steering and braking systems
2. Hydraulic systems of tractors
3. Working place of driver, ergonomic parameters

**5. Tillage Machinery**

1. Primary Tillage Machinery
2. Moldboard Ploughs
3. Rotary Cultivators

**6. Seeders**

1. Drawn Secondary Tillage Tools
2. Seedbed Combinations
3. Seeders

**7. Fertilizer Distributors**

1. Manure Spreaders
2. Fertilizer Spreaders
3. Uniformity of fertilizing

**8. Pest Control Equipment**

1. Non – Chemical Techniques for Pest Control
2. Sprayers
3. Mistblowers

**9. Forage Harvesting Machines**

1. Mowers, Conditioners
2. Self – loading Wagons, Balers
3. Forage Harvesters

**10. Grain harvesting machines**

1. Combine Harvesters-functional components, technological process
2. Differences between axial and tangential combine harvesters
3. Rotary combines

**11. Information and control systems on Combine harvesters**

1. Main aim of information and control systems
2. Grain throughput measurement
3. Yield mapping

**12. Root Crops Production and Harvesting Machines**

1. Precision Drilling Machines
2. Potato Planters
3. Sugar Beet and Potato Harvesters

**13. Technological equipment of cattle houses**

1. Housing technology in cattle houses
2. Feeding technology and machinery of cattle houses
3. Waste handling and treatment in cattle farms

**14. Milking machines**

1. Principles and construction of milking machines
2. Milking parlours and milking robots
3. Milk treatment and milk cooling systems

**15. Technological equipment of pig houses**

1. Housing technology and machinery of pig breeding houses
2. Housing technology and machinery of pig fattening houses
3. Feeding technology, waste handling and treatment in pig farms

**16. Technological equipment of poultry houses**

1. Incubators
2. Technological equipment of broiler chicken houses
3. Technological equipment of laying houses

**Logistics and Management in Agriculture**

Logistics

Explanation of the term „logistics“, various definitions of logistics

Strategic goals of logistics

Historical development of logistics

Logistic performance

Logistic costs

Logistic key performance indicators

Conflicts of logistic concerns in a firm

Principles of material flow management

Push and pull systems

Decoupling point, effects of decoupling point location

Optimization of decoupling point location and limiting factors

Supply chains

Bullwhip effect, causes and consequences of bullwhip effect

Ways to eliminate bullwhip effect

Synergies in supply chains, explanation of the term “synergy”

Manufacturing logistics

Types of manufacturing and manufacturing systems

Pull systems in manufacturing – JIT, Kanban

Push systems in manufacturing – MRP

Demand forecasting

General comparison of demand forecasting methods

Exponential smoothing

Methods based on seasonal indexes

Inventory management

Functions of inventories

Warehousing costs

Methods used in inventory management: ABC analysis, EOQ

Distribution systems

Explanation of the term “distribution”

Distribution systems – 3x3 and 3+3, hub and spoke

Comparison of means/types of transportation, intermodal transportation

Mobile Units

Characteristics, Engine Power to Drawbar Power Transmission, Traction

Drawbar Performance – Factors, Optimization

Implement Draft, Matching Tractor and Implement

Mobile Machinery Capacity

Shift Time Structure, Time Efficiency

Workrate – Calculation, Factor Analysis

Transport Mean Workrate – Factor Analysis

Mobile Machinery Lines

Classification of Mobile Machinery Lines

Matching Line’s Equipment

Requirement for Transportation Means

Mobile Machinery Costs

Machinery Cost Structure, Fixed Costs

Machinery Variable Costs, Repair and Maintenance Cost Estimate

Fuel Consumption Management and Estimate

Indices of Machinery Service Assessment

Classification of Indices

Machinery Cost Analysis, Operation Specific Costs

Direct Labour Consumption, Machinery Work Consumption

Acquiring Mobile Machinery Services

Methods of Acquiring Machinery Services

Minimum Annual Use of Machinery in Relation to Years of Use

Machinery Service Market Price, Calculation

Mobile Machinery Replacement

Criteria Applied when Selecting Mobile Machinery

Multicriteria and Graphical Methods of Machinery Comparison

Methods of Machinery Requirement Calculation, Machinery Replacement Plan

Information Technologies within Mobile Machinery Service Management

Information Technologies within Machinery Service based on the Internet

Systems of Monitoring and Assessment of Machinery Service

Application of GIS within Machinery Service Management

**Environmental Engineering**

1. Waste landfill (waste site)
   * + 1. Logistic means
       2. Compactors
       3. Degasification of landfill, landfill gas utilization
2. Anaerobic biowaste processing
   * + 1. Common scheme of machines line for anaerobic biowaste processing
       2. Cogeneration unites
       3. Solid-liquid separators
3. Aerobic biowaste processing
   * + 1. Common scheme of line for compost production
       2. Disintegrators, turn up machines, separators
       3. Compost reactors, heap composting
4. Waste incineration
   * + 1. Heat value of solid waste
       2. Press, briquette machines, pellet machines
       3. Small-,medium-,large-boilers
5. Population ecology and management
   * + 1. Population size, dynamics and trends
       2. Dispersal and spatial patterns
       3. Metapopulation concept, nature reserves designing
6. Catching, marking and monitoring
   * + 1. Catching methods in birds, mammals and invertebrates
       2. Marking and monitoring of birds and mammals
       3. Radiotelemetry
7. Community ecology
   * + 1. Analysis of structures of plant / animal communities
       2. Nature of predation, predator-prey relationships, ecological traps
       3. Competition, niche concept, biological invasions
8. Quantitative ecology
   * + 1. Survival analysis, spatial pattern analysis
       2. Indices of diversity and similarity
       3. Ordination techniques, cluster analysis
9. Soil water content
   * + 1. Expressions of soil water content
       2. Determination of soil water content
       3. Porosity of soil, determination and relation to the water content
10. Soil water potential and soil water retention curve (SWRC)
    * + 1. Definition of soil water potential
        2. Retention curve, definition and possibilities to express
        3. Analytical equations for SWRC, use of SWRC in practice
11. Hydraulic conductivity
    * + 1. Definition of saturated hydraulic conductivity K of soils
        2. Determination of K in the field and laboratory
        3. Use of K for the calculation of water flow in soils
12. Infiltration of water to the soil profile
    * + 1. Describe infiltration as the process in the nature
        2. Infiltration tests in the field and their evaluations
        3. Mathematical description of the water infiltration process in soil
13. Waste Recycling and waste neutralization – Soil decontamination
    * + 1. Benefits and problems with waste incineration
        2. Which are the methods to soil decontamination
        3. Biogas uses in rural areas:
14. Ecological engines
    * + 1. Methods to design and use “environmental engines”
        2. Some advantages of methanol like bio fuel.
        3. Description of Bio diesel (making up, uses, advantages)
15. Agricultural wastes
    * + 1. Description of Aerobic slurry treatment
        2. Composition of agricultural waste
        3. Dunghill description
16. Renewable source of energy
    * + 1. Disadvantages of hydropower
        2. Disadvantages of wind energy
        3. Description of electricity generation using parabolic trough solar power plants