

Manufacturing systems and processes – Manufacturing systems

Production logistics

- Types and trends– ordering logistics (purchasing, selection and evaluation of suppliers), manufacturing logistics – distribution logistics. Trends which influence production logistics – transportation and packing technologies, new manufacturing and manipulation technologies, Design for Log etc.
- Modern principles in production systems management – Push, Lean, TOC, JIT/JIS, SCM etc.
- Analytical tools – 8 types of waste, Pareto analysis, ABC and XYZ analysis, Spaghetti diagram, Sankey diagram, Process diagram, REFA.
- Capacity equations and saw tooth diagram – Manufacturing batch according to capacity equations and TOC, transport batch, inventory turnover, inventory turnover duration, safety stocks and re-order point.
- Information systems in production logistics (SCM, ERP, APS, MES, WMS) and systems of automatic identification (Barcode, QR, RFID, RTLS).
- Warehouse management - general warehousing legislation – work safety in the warehouse inventory stacking, personal protective equipment, escape zones etc.
- Warehouse equipment and control in the Industry 4.0 - OCADO/KIVA robotics, Karakuri, Pickit - Robot vision, Pick by voice/light/point/frame/VR/video mapping etc.

Design of manufacturing systems

- Principles of material and information flow design and manufacturing cell design
- Difference between technology, product and production cells organization of workplaces,
- Motion studies MTM and MOST.
- Work Ergonomic,
- Triangle and Craft layout planning.
- The use of capacity equations for design of manufacturing systems.

Simulation of manufacturing systems

- Terminology – definition of simulation, Computer aided and computer less simulation. Discrete and continues simulation. Dynamic simulation. Stochastic elements. Simulation of logistics and manufacturing.
- Simulation project – steps of simulation project. Analytical tools and the Simulation (advantages and disadvantages). Validation and verification requirements. Input data and results interpretation. Simulation project evaluation.
- Simulation experiments – simulation detail levels. Design of experiments planning. The function of warmup in the simulation (witness). Costs and benefits of computer aided simulation (qualitative and quantitative).
- Simulation optimization – factors and parameters. Simulation indicators (throughput, resource utilization, blocking, waiting etc.)

3D Technology and Rapid Prototyping (Additive Technology)

- Additive technology – definitions, advantages and disadvantages compared to other manufacturing technologies.
- Production preparation using additive technologies - used input data format and its properties, common steps of production preparation using additive technologies based on 2D slices.
- Overview of additive technologies – description of the part printing principle by the most common additive technologies, according to the input material in the form of liquid photopolymers, powders and solids.
- Hybrid technologies – overview of technologies combining additive manufacturing and machining, advantages and disadvantages, description of basic used methods.

Metrology and 3D measurement

- Introduction to metrology – basic overview, terminology, measurement errors, types of measurement uncertainties.
- Contact 3D measurement – coordinate measuring machines, types of constructions, basics of measuring, probes and stylus.
- Contactless 3D digitization, basic methods and principles, orientation in the global coordinate system, used devices, areas of use.
- Processing of scanned 3D data, basic dimensional and shape inspection procedures, point cloud, mesh, CAD alignment (BestFit, 3-2-1, RPS), creation of geometric elements, geometric dimensioning and tolerancing (GD&T).

Programming of CNC machines

- Basic characteristics of NC / CNC machines – types of machines, basic overview, classification of CNC machines in manufacturing systems, areas of application, peripherals of CNC machines.
- Coordinate systems on CNC machines – machine axis definition, basic rules of linear and rotary axes arrangement on CNC machines, definition and meaning of machine reference points.
- Basic tasks of preparing a CNC machine for automatic production – tool offsets measuring, work-piece zero-point shift, comparison of NC program creation methods.
- NC program in ISO format – NC program structure, general NC program block format, basic tool movements (rapid feed, feed rate, circular interpolation, machining cycles), miscellaneous functions (M function), feed and speed functions, tool selection – format and meaning.