The comparison of the lectures "Orientatie produktietechniek B" with the book "Manufacturing engineering and technology"

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CONTENTS

1. INTRODUCTION

In this report the contents of syllabi used for the lecture "Orientatie Produktietechniek B "are compared with the book "Manufacturing Engineering and Technology" written by Serope Kalpakjian [K].

The syllabi, on one side, that have to be compared with the [K] book on the other side, are :

1. Deel 1 : "Inleiding mechanisatie en automatisering B" –syllabus
2. Deel 2 : "Verspanende bewerkingen, Verspanende werktuigen B" –syllabus
3. Deel 3 : "Omvormende bewerkingen, Omvormwerktuigen B" –syllabus
4. Deel 6 : "Meten en controleren" – the written records from the lectures

The main contents of the Kalpakjian's book [K] is devided into eight parts, which are :

General Introduction
part 1 : Fundamentals of Materials: Their Behavior and Manufacturing Properties
part 2 : Metal–Casting Processes and Equipment
part 3 : Forming and Shaping Process and Equipment
part 4 : Material–Removal Processes and Machines
part 5 : Joining processes and Equipment
part 6 : Surface Technology
part 7 : Common Aspects of Manufacturing
part 8 : Manufacturing in a Competitive Environment

These parts consist of the chapters that consist of the sections. The sections consist of the subsections.

Example: part 7 : Common Aspects of Manufacturing
chapter 35 : Engineering Metrology
section 35.3.: Line–Graduated Instruments
subsection 35.3.2. : Linear measurements

Since the syllabi are currently used for the lectures "Orientatie Produktietechniek B", I will use these syllabi as the starting–point in my report. About every chapter or main paragraph I will write a brief summary, followed by the location(s) where this subject can be found in Kalpakjian's book. Additionally, in the case when two subjects don't match completely, a short remark about the diffrences is given.

2. SYLLABUS : Deel 1 : INLEIDING MECHANISATIE EN AUTOMATISERING B

The syllabus "Inleiding mechanisatie en automatisering B" contains of the following chapters:

1. Wat is bedrijfmechanisatie, wat is mechanisatie
2. Materialen en bewerkingsprocessen bij de vervaardiging van producten in grotere aantalen
3. Hulpmiddelen in de bedrijfsmechanisatie
4. Computer Aided Manufacturing
5. De inrichting van de vervaardigingsprocessen t.b.v. mechanisatie
6. Aanpassen van het product aan de fabrikagemethode
7. Sociale aspekten
8. Ekonomische aspekten

This syllabus gives the students an introductional description of factories mechanisation and automation. The eight main chapters [Hoofd.] can be in general compared to [K] :

part 8 completely

part 7 : chapter 37 : Human–Factors Engineering, Safety, and Product Liability

the intrudoctions of the parts 2,3,4,5,6

General Introduction

Since [K] book contains more information about this subject, I will list first the contents of syllabus, followed by the locations where this subject can be found in [K]. Additionally, I will list also the corresponding chapters, sections and subsections of [K] with a brief summary, followed by the location where this subject can be found in the syllabus (for example : *Hoofd.1*). The subsections without the location number do not have any corresponding chapter in the syllabus, but their contents belongs to the syllabus.

2.1. Description of the chapters of Deel 1 and general comparison to [K]

Hoofdstuk 1 : Wat is bedrijfmechanisatie

This chapter is the introduction, consisting of some examples, history of the mechanisation of factories.

Wat is mechanisatie

The chapter describes the definition of the word "mechanisatie" and the requirements for mechanisation in five main topics. We can compare this chapter with the sections 38.1, 38.2.2 of [K]. A more general description can be found in the General Introduction in the parts called : What is Manufacturing ; Examples of Manufactured Products.

Hoofdstuk 2 : Materialen en bewerkingsprocessen bij de vervaardiging van producten in grotere aantallen

The main topics in this chapter are: de elementen van de vervaardingingcyklus, de onderdelenfabrikage, de montage, de kontrole van gereedprodukten het verpakken. The sections from [K] which agree with are: 38.2, 38.2.2, 40.2, General Inroduction – the part called : Selecting Materials and Selecting Manufacturing Processes.

1 : Metaalbewerkingsprocessen

Verspanen,uitsnijden,vervormen,gieten,smeden,extruderen,chemische en fysische processen.

This part is discussed in [K] in the General Introduction – the part called : The Design Process; and in the introductions of the part 2 and part 3 .

2 : Overige processen

This part is discussed in [K] in the General Introduction and in the introductions of parts 2,3,4,5,6.

Hoofdstuk 3 : Hulpmiddelen in de bedrijfsmechanisatie

3.1. De zelfwerkende machine
a) zelfkontrolerende werking
b) zelfherstellende werking
3.2. De zelfwerkende, zelfkontrolerende machine
Automatisering
3.3. De zelfwerkende, zelfkontrolerende en zelfherstellende machine
Zelfoptimaliserende
This chapter is treated in [K] in part 8 in the subsections 38.2.2, 38.2 3, 38.2.4, 38.3, 38.3.1, 38.3.2, 38.3.3, 38.3.4, 38.3.5, 38.4, 38.4.1, 38.4.2, 38.5, 38.5.1, 38.6 in complete, 38.7, in the General Introduction – the part called : Design for Manufacture, The Design Process and Selecting Manufacturing Process.

Hoofdstuk 4 : Computer Aided Manufacturing (CAM)

Flexibele automatisering
Flexibele industriele automatisering
This chapter is described in the General Introduction – the part called Automation and the Impact of Computers on Manufacturing; and in the part 8 – in the same sections as described in hoofdstuk 3.

Hoofdstuk 5 : De inrichting van de vervaardigingsprocessen t.b.v. mechanisatie

This chapter consists of the examples of manufacturing products which are also given in [K] in the General Introduction – the part called Examples of Manufacture Products; more examples are given in chapter 38.

Hoofdstuk 6 : Aanpassen van het produkt aan de fabrikagemethode

This chapter agrees with the General Introduction – the part called Assembly; and with the sections 38.6,38.10, 38.10.2, 38.10.3.

Hoofdstuk 7 : Sociale aspekten

The contents of this chapter matches the General Introduction – the part called Organization of Manufacturing; and the part 7 of [K].

Hoofdstuk 8 : Ekonomische aspekten

The contents of this chapter correspond with the General Introduction – the part called Economics of Manufacturing; and with the part 8.

2.2. A general summary of the above-mentioned parts, chapters, sections and subsections of [K], which were considered to contain the same information as Deel 1.

General Introduction

*** What is Manufacturing**

The explanation of this term in a broad sense, description of the origin of the word , history, demands and trends of manufacturing, is given in this section also with a figure of the relationships among many activities in manufacturing.

*** Examples of Manufactured Products**

From diverse examples the requirements of all thought processes that are common to making all products during each manufacturing operation is given. The illustrated examples are: paper clips, transistors, incandescent light bulbs, jet engines.

*** Design of Manufacture**

A general explanation of this term with a listing of all consisting processes and knowledges is given.

*** The Design Process**

Various steps involved in designing and manufacturing are described by chart. It includes also table with shapes and some common methods of production which give the summary expression of all English terms used in the production.

*** Selecting Materials**

The general types of materials used in manufacturing and the general consideration of their properties is given.

*** Assembly**

–Design for assembly

the basic consideration of assembly work are named

–Automation and the Impact of computers on manufacturing

general information about nowadays utilization of computers, CAD and CAM

–Machine control systems

–Computer technology

*** Economics of Manufacture**

A general description of costs and all categories involved is listed.

*** Organization for Manufacture**

A typical organisation chart of a manufacturing company is given.

part 8 : Manufacturing in a Competitive Environment
chapter 38. : Automation of Manufacturing Processes
section 38.1.: Introduction

It describes the beginning of manufacturing from a historical point of view, a major concern of productivity and expleins also the beginning of mechanization.
**Hoofd.1, 2

38.2. Automation

It explains the definition of the process and a concept of automation. The description of a basic area of activities where automation were implemented is given in :

–Manufacturing processes: Machining, forging, cold extrusion, grining

–Material handling

–Inspection

–Assembly

–Packaging

**Hoofd.2

38.2.1. Evolution of Automation

The explanation of history : table – machine tools numerical control, table– developments in the history of automation of manufacturing processes CNC, CIM, CAD–CAM

**Hoofd.1, 2, 3, 4, 5

38.2.2. Goals and applications of automation

Several primary goals are described, also is discussed the production : experimental, piece or small batch, batch or high volume, mass production, and aplications of automation.

**Hoodf.1, 2, 3, 4

38.2.3. Hard Automation

This section explains above term as the production of machines which are designed to basically engine blocs, valves, gears spindels. It describes also a Powderhead Production unit and Transfer mechanisms.

**Hoodf.3

38.2.4. Soft Automation

The description that Soft Automation is achieved through numerical control of the machine and its various function is given. It contents also the discussion that soft automation has led to the development of flexible manufacturing system.

**Hoofd.4

38.3. Numerical Control

The explanation of this term is given and a brief review of a process of traditional manual method of machining is listed. The examples of numerical control of machining and the areas of a major impact of NC are present.

**Hoofd.3, 4

38.3.1. Historical background

The principle of binary punch – tape code is also explained.

38.3.3. Computer numerical control

In this section is explained the division into a direct numerical control and computer numerical control.
**Hoofd. 3, 4

38.3.4. Principles of NC machines

This section gives a schematic illustration of the major components of NC tool. It devides the functional elements into data input, data processing, data output and describes types of control system, open–loop system, cloosed–loop system.
**Hoodf.3, 4

38.3.5 Types of Control System

There is given the explanation of point–to–point system and contouring.

38.3.6. Accuracy in Numerical Control

Given the positioning accuracy 3um, repeability 8um, resolution 2,5um.

38.4. Programming for Numerical Control

38.4.1. Manual Programming

In this section is explained an engineering drawing of the part as dimensional relationships and creating out the operations.

38.4.2. Computer–aided programming (CAP)

On the figure is given outline of two methods of computer–aided part programming. Also is explained above term and its significant advantages over manual methods. There is given the example: NC programming for machinning.
**Hoofd.4

38.5. Adaptive control (AC)

In this section are defined the purposes of AC and explanation of this term.

38.5.1. Principles and applications of adaptive control

In this section is described an adaptive control constraint system (ACC) and an adaptive control optimization (ACO) and the example on the figure of milling.
**Hoodf. 3, 4, 5

38.6.1. Method of Material handling

There are named the factors for the choosing a suitable material handling method
**Hoodf.3, 4, 5

38.6.2. Equipment

A brief review of various types of an equipment is named, description of manipulators is given and automated guided vehicles (AGVs).

38.7. Industrial Robots

The robots are in this section defined as a reprogrammable multifunctional manipulators, design to move materials, parts, tools; manipulators that are activated directly by an operator. There is given also the ISO definition.
**Hoofd.3, 4

38.7.1. Components

Figure: components of a typical industrial robot
Description of parts which are devided into a manipulator, an end effector and its equipment, a power supply, control system, feedback devices
**Hoodf.3, 4

38.7.2. Classification

The classification is maden as the devidion into: a fixed–and variable–sequence robot, playback robot, numerically controlled robot, intelligent (sensory) robot. The figure showes also other types of industrial robots.
**Hoodf.3, 4

38.7.3. Applications and selection of robots

The major applications are listed; also the factors that influence the selection of robots in manufacturing plants are listed. There is explained also the economics of robots.

38.8. Sensor Technology

There is given the division into the analog and digital sensors.

38.8.1. Classification

Sensors are devided into: mechanical, eletrical, magnetic, thermal, others.
In this section is explained also the term of tacticle sensing and visual sensing. There is also given the figure of inspection of tie rod assembly with machine vision.

38.9. Flexible Fixturing

There is given the general explanation of this term.
**Hoofd.3, 4

38.9.1. Design consideration for flexible fixturing

In this section is given the example of the flexible fixturing of turbine blades.
**Hoodf.5 ,6

38.10. Automated Assembly

This section gives a general explanation of this term.

38.10.1. Assembly methods

In this section is given the division into the random assembly and the selective assembly.

38.10.2. Assembly system

There is given the explanation of a synchronus and nonsynchronus system and the flexible assembly system.
**Hoodf.4, 5, 6

38.10.3. Design for assembly (DFA)

There are a certain lines estabilished as an aid in the design of parts for automated assembly.

chapter 39. Integrated Manufacturing System

39.1. Introduction

39.2. Manufacturing Systems

The word of system, the sense of system and model is described.

39.3. Computer–Integrated Manufacturing (CIM)

The description of this term is given with the benefits of CIM.

39.3.1. Database

The explanation of the items which is generally database consisting of, also the explanation of data acquisition system (DAS) and its components is given.

39.4. Computer–Aided Design

The explanation of this word and the function. On the figure is also explained the connections with CAM. Examples of CAD mechanical designs and the geometric modelling. There is given also the explanation of the creating design drawings by CAD.

39.4.1. Advantages of CAD system

Description of the work of designer, his problems, task, and possibilities.

39.4.2. Elements of CAD systems

It describes four stages of which consists the CAD system and on the figure is tke computer simulation of impression–die forging.
**Hoodf.4

39.5. Computer–Aided Manufacturing (CAM)

The explanation of this word, explanation of CAD/CAM system and typical applications of CAD/CAM are included.
**Hoofd.4

39.6. Computer–Aided Process Planning (CAPP)

The general explanation of the term.

39.6.1. Advantages of CAPP systems

The explanation of the standartization of process, plan, improving productivity .

39.6.2. Elements of CAPP systems

There are discussed the database of CAPP and the division into different types: retrieval, variant and generative system .

39.6.3. Material–requirements planning and manufacturing resource planning (MRP)

The explanation of this word as the keeping complete records of inventories of materials, supplies, parts in various stages of production, orders, purchasing, scheduling.

39.7. Group Technology (GT)

The description of this term, history and an example of grouping parts according to their geometric similarities.

39.7.1. Advantages of group technology

There are named the advantages with the explanation.

39.7.2. Classification and coding of parts

The explanation of classification and coding systems (CC) is named, the design attributes and the manufacturing attributes are considered.

39.7.3. Coding system

It describes three basic levels of coding; the hierarchial coding, polycodes, decision–three coding. There is given also the description of two major industrial coding systems : the Opitz and MultiClass system.

39.8. Cellular Manufacturing

The general explanation of this term.

39.8.1. Manufacturing cell design

39.8.2. Flexible manufacturing cells (FMC)

It contains the explanation and the schematic view of FMC on the figure.
Example: manufacturing cells in a small machine shop

39.9. Flexible Manufacturing Systems (FMS)

The explanation of the word, history of developments and the benefits of FMS.

39.9.1. Elements of FMS

The elements of FMS : workstations, automated handling, transport of materials and parts and control systems are described.

39.9.2. Scheduling

The scheduling for FMS which is dynamic is explained.

39.9.3. Economic justification of FMS

The cost, installation, and personeel which is necessary for FMS, also the type of production where is the most effective is discussed.
Example: flexible manufacturing systems in large vs. small companies

39.10 Just-in-Time Production (JIT)

It describes the concept of goals and discusses them.

39.10.1. Kanban

The history of JIT is explained under the origin name of JIT kanban.

39.10.2. Benefits of JIT

The advantages of JIT are listed.

39.11. Manufacturing Automation Protocol

In order to maintain a high level of the coordination and effeciency of operations in integrated manufacturing, an extensive, high-speed, and interactive communication network is required. Local area network (LAN) is described on the figure.

39.11.1. Communications standard

The history, function and manufacturing automation protocol is described (MAP).

39.12. Artificial intelligence (AI)

The explanation of the word and the history is described.

39.12.1. Elements of artificial intelligence

It explains the activities in AI:

-expert systems-explanation, the most common languages listed (LISP,PROLOG) and list of several expert systems developed since 1970s

-natural langauages processing-

-machine vision-

Example : application of expert system in TV picture-tube making

39.13. Factory of the Future

The discussion about an unmanned factory in which a human being would not be directly involved with the production on the shop floor.

39.13.1. Impact on the labor force

The discussion about a labor force which will shift to an indirect labor force using CAD/CAM.

chapter 40. Competitive Aspects and Economics of Manufacturing

40.1. Introduction

40.2. Selection of Materials

**Hoodf.2, 5, 6,7, 8

40.2.1. Mechanical, physical and chemical properties

40.2.2. Shapes of commercially aviable materials

The description of each manufacturing process which produces parts or stock that have their own shape, surface, finish and tolerance characteristic is given. These characteristic are in catalogus.

40.2.3. Manufacturing properities

In this section are discussed manufacturing properties such as : castability, formability, machinability, weldability, hardenability by heat treatment in accordance with quality of materials.

Example: effect of workpiece hardness on cost in drilling

40.2.4. Reliability of supply

Short discussion about affect the reliability of supply is given.

40.2.5. Cost of materials and processing

There are discussed the cost of materials in accordance with the purchase quantity, also some examples are shown on the table.

40.3. Product Design and Quantity of Materials

There are discussed the problems of the implementation of new design techniques and minimizing the amount of materials with some examples.

40.4. Substitution of Materials

The examples of reasons for substituting materials are listed and discussed.

Example : Alluminium vs. stell cans.

Example : material substitution in vacuum cleaner

40.4.1. Substitution of materials in the automobile industry

Severe examples of substitution of materials are given also in table.

Example : material substitution in automobile engines

40.4.2. Substitution of materials in the aircraft industry

On the figure are shown the parts where the substitution of materials was done.

Example : materials changes from C–5A to C–5B military cargo aircraft

40.5. Selection of Manufacturing Process

The section describes the importance of proper manufacturing process and machinery selection, and how the selection process relates to characteristic of materials, tolerances, surface finishes obtained, and cost. The considerations for the choice of manufacturing process are listed.

Example : Process selection in making a part

40.6. Process Capabilities

The different capabilities of a different process are discussed.

40.6.1. Tolerances and surface finish

The importance of tolerances and surface finish in the accordance with design and cost are discussed.

40.6.2. Production volume

The explanation of the term of the economic order quantity.

Example : economical quantities for different production methods

40.6.3. Production rate

There is discussed a significent factor in selection of production rate for different processes.

40.6.4. Lead time

In the sectin is described lead time as a time required to start production for different processes.

40.7. Manufacturing Cost

The various costs involved in manufacturing the products are described and the factors which can minimize cost, while maintaining quality are considered. Also the items of which the cost consists of are listed.

40.7.1. Material Costs

In the section 40.2. is described material cost, also some costs are given in various tables.

40.7.2. Tooling costs

The influence by the selection of production process is discussed on the example.

40.7.3. Labor cots

The division into a direct and indirect cost, and the explanation of each is given with examples.

40.7.4. Fixed costs

The explanation as a cost which the company would have to pay regardless of whether it made particular product. Also the explanation of the term of the capital cost is given.

40.7.5. Relative costs

The dependence of the relative cost explained on the examples.
Example : Cost comparison in making gears by machining and powder metalurgy
Example : cost comparison in producing a part

40.7.6. Manufacturing costs and production volume

On the tables is explained the unit cost of a product as a function of production method and quantity and on another graph figure the relative cost of labor, materials and capital as a function of annual production volume.

40.8. Value Engineering

The explanation of the term, utilization of Value Engineering. Several groups of questions are listed to properly asses the value of each step in manufacturing product in: product design, materials, manufacturing process.

part 7 : Common Aspects of Manufacturing
chapter 37.: Human–Factors Engineering, Safety, and Product Liability
section 37.1.: Introduction

37.2. Human–factors Engineering
The explanation of the factors which Human–Factors Engineering deals with is given.

37.2.1. Workstations
The explanation of a good arranged and designed workstation and all aspects are discussed.

37.2.2. Environmental conditions
There are discussed the environmental conditions in the consideration with engineering psychology.

37.2.3. Noise
On the figure are given typical sound levels for various operations and various types of machinery at operators position.

37.3. Safety
The definition of this word, the meaning of hazard, and risk is discussed.

37.3.1. Safeguarding
Certain safeguarding methods which have been developed are described : barrier guards, safety devices, lockouts, warnings, personal protective equipment

37.4. Product Liability
There are discussed the problems of enjuries in the job.

37.4.1. Negligence
There is disscussed concept of comparative negligence.

37.4.2. Strict liability

The discussion what the plaintiff must prove under the legal theory of the strict liability.

37.4.3. Defects

The discussion of the word, named the factors which involved the defective product. Also the discussion about the warnings and instructions.

Example : press builder liable for failure to warn

Example : guarding of multipurpose press brake

37.4.4. Designing and manufacturing safe products

The basic guidelines for designing and manufacturing safe products are listed and discussed.

3. SYLLABUS : Deel 2 : VERSPANENDE BEWERKINGEN, VERSPANENDE WERKTUIGEN B

The syllabus "Verspanende bewerkingen, verspanende werktuigen B" contains of three main chapters :

1. Hoofdstuk 4 : Technologische informatie
2. Hoofdstuk 5 : Werktuigen
3. Hoofdstuk 6 : Werkvoorbereiding

The syllabus Deel 2 has a corresponding contents mainly in [K] in the part 4: Material–Removal Processes and Machines, in the chapters 20,21,22,23,24. For the work with this syllabus, I will first list the chapters of syllabus, and immediately after that, I will list the matching sections of [K] with brief summary and the location number.

Hoofdstuk 4 : When I've compared a corresponding sections of [K] with this chapter I have found that: [K] has very general descriptions, doesn't describe detail formulas and equations, explaines the problems on the tables and pictures and some practical examples, but doesn't expect the reader to be busy with the calculations. [K] includes in all examples of simple calculations no standard and standard units.

Hoofdstuk 5: In [K] is given about same explanation with more pictures, more information about lathes, less examples of the calculation.

Hoofdstuk 6 : [K] doesn't consist of corresponding section, it includes more general description.

3.1. Description of the chapters of the syllabus Deel 2 and the general comparison to [K]

Hoofdstuk 4 : Technologische informatie
4.1 Inleiding

In this chapter is given the general introduction into the part of production for which are necessary the technological information such as : cutting forces, cost of the tools, quality of the surface.
The matching sections of [K] are 20.1. Introduction; 23.3.5. Selection of cutting parameters; 23.3.6. Design and operating guidelines for milling.

4.2. Snijkrachten

This article consists of the equation for "de hoofdsnijkracht F"described by Kronenberg and number of exercises for the calculations F.
In [K] section 20.5. Cutting Forces and Power is described by the picture of the forces acting on the tool. They are expressed as cutting force F which acts in the direction of the cutting speed v and the thrust force F acts in the direction normal to the cutting velocity. As a result is a resultant force R, which can be resolved into a friction force and normal force. There is given the equation for expression of a coefficient of friction. There is given the example for the calculation of the direction of force and the general equation for the calculation of the power and the specific energy for shearing, and friction. The figure 20.12.: forces acting on cutting tool in two dimensional cutting; is similar to the figure 2.22 in the syllabus. The section 22.3. describes the turning parameters and process capabilities. An example gives the calculation for material removal rated cutting force in turning actual time to cut. The section 22.6 gives an example of material removal rate and torgue in drilling.

4.3. Gebruiksduur van het gereedschap

In this article is given the explanation of "effective gebruiksduur" and "nominale gebruiksduur". In the "opgave–enkele voorbeelden van aanbevellingen voor het gebruiksduurkriterium op grond van werkplaatservaring" and the criterium for the calculation "gebruiksduur T and snijsnelheid v" from W. Taylor is given. There is, furthermore, given the formula for "Taylorrelatie (4.4)".
In the section 20.7. Tool Wear and Failure is given an explanation of two basis regions of wear in cutting tool : flank wear and crater wear. In the section 20.7.1. is expained the flank wear and estabilished Taylorrelationship (20.18) and tool–life curves for different materials. There is also the table of the allowable wear land for cutting tools in various operations and discussion of optimum cutting speed. In the excample is presented effect of cutting speed on material removal. In the section 20.7.2 is explained the crater wear as the result of diffusion mechanism. More explananation about this subject is given in sections 20.7.3. Chipping; 20.7.4. General observations on tool wear; 20.7.5. Techniques for measuring and monitoring wear; 23.2. Milling operations; 23.2.1. with an example for the calculation of material removal rate, power required, and cutting time in slab milling. In the section 20.2. Mechanics of chip are given equations for cutting ratio (20.1), shear strain (20.2), friction angle (20.4) and velocity of the chip out of trigonomerric relationships, thickness and depth of chip. In the part Questions and problems we can find the general questions about chip velocity, tool life, the calculations by use of Taylor equation.

4.4 Oppervlaktekwaliteit

In this article is given a basic knowledge about "ruwheid als maat voor de oppervlaktekwaliteit". There is given the equation for "de grootste diepte van het ruwheidsprofiel" and "de grootste diepte" by use of neusradius. Furthermore, there is given the example for the calculation of "de grootste diepte "
This contents can be compared to the section 20.8. Surface Finish and Integrity, where is very general description of factors influencing the surface integrity and the discussion about feed–marks. Other information about surfaces are in part 6 : Surface Technology, where in the section 31 is the general description of the surface structure and properties, surface integrity , surface texture and surface roughness. The section 25.6.1. gives more information about surface grinding.

Hoofdstuk 5: Werktuigen

5.1. Inleiding

This article matches with the General Introduction – table 1 , which gives the historical development also for tools.

5.2. Geleidingen

In this article is given special discussion and figures of the different types of guideway. This subject is not present in [K].

5.3. Gereedschapswerktuigen

5.3.1. Inleiding

This article gives an introduction into different machine tools and their functions. In [K] in the introduction of the part 4 is given in the figure the outline of processes, which is similar to fig. 5.6.

5.3.2. De schaafbank

The description with a figure of " de schaafbank" we can find in the section 23.4. Planning and Planners. There is on a figure given a schematic illustration of a planner, named the process parameters and design considerations.

5.3.3. De boormachine

In this article is given the explanation of drilling machine. This article matches the section 22.7. Drilling Machines of [K], where is explained the function with illustrations of vertical drill press, radial drill press, and three–axis computer numerical control drilling machine. Furthermore, the section 22.5. deals with the introduction of Boring and Boring Machines. The section 22.6. Drilling and Holemaking Operations, describes in the section 22.6.1. Drills on the figure 22.24. and the table 22.8. gives the general recommendations for drill geometry, whichis similar to fig.5.12. of the syllabus. The figure 22.25 corresponds with fig.5.11.of the syllabus.

5.3.4. De draaibank

In the example on the picture of "centerdraaibank" are explained the parts of "draaibank". The same explanation is found in the section 22.2. Lathes, with schematic illustration of the components of lathe, figure 22.2.. The various operations that can be performed on the lathe are given on the figure 22.2., corresponding with fig.5.18.. In the section 22.2. is furthermore given the lathe specifications, workholding devices, accesories and attachements, lathe operations, tracer lathes, automatic lathes, turred lathes, computer–controlled lathes.

5.3.5. De freesbank

In this article is given the explanation of "de belangrijkste freesprocessen", same as in [K] in the section 23.2. Milling operations, on the figure 23.2..This article describes the "konsole–freesmachine" and "bed–freesmachine", same as the section 23.3. Milling Machines; the subsection 23.3.1. Column–and–knee type machines; and 23.3.2. Bed–type machines. In the section 23.2.and 23.3. is given much more information about milling and milling machines.

5.4. De hoofdaandrijving

In this article is given the discussion about economical use of the turning tools, there is estabilished the "regelfactor R" and explained the "regelreeks, meetkundigereeks, Renard–reeks". Only in the section 22.3. Turning parameters and Process Capabilities are given the information about the turning parameters, material removal rate, on the example materal removal rate and cutting force in turning. The section 23.2.2. Face Milling gives some examples of the calculation of material removal rate, power required and cutting time in face milling. In the section 24.5. Machining Economics is disscussed the total cost per piece.

6. Werkvoorbereiding

6.1 Inleiding
6.2. Draaidiagram
6.3. Berekeningsvoorbeeld
6.4. Boordiagram

These more specific chapters don't have any corresponding sections in [K]. In [K] are some examples of the calculations, which were already named. Material removal rate for drilling is expressed in the section 22.6.3..

4. SYLLABUS : Deel 3 : OMVORMENDE BEWERKING, OMVORMWERKTUIGEN B

The syllabus "omvormende bewerkingen, omvormwerktuigen B" has the following chapters:

1. Hoodfstuk 1 : Inleiding
2. Hoofdstuk 2 : Het stansen
3. Hoofdstuk 3 : Dieptrekken
4. Hoofdstuk 4 : Het duntrekken
5. Hoofdstuk 5 : Massief omvormen
6. Hoofdstuk 6 : Keuze van gereedschappen
7. Hoofdstuk 7 : Procesindeling naar geometrie
8. Hoofdstuk 8 : Omvormmachines algemeen
9. Hoofdstuk 9 : Hydraulische pers
10. Hoofdstuk 10: Mechanische persen

The syllabus Deel 3 has a corresponding contents mainly in the part 3 of [K]. For the work with this syllabus, I will first list the chapters of syllabus and immediately after that, I will list the matching sections of [K] with a brief summary and the location number.

This syllabus has a different subject–division structure of the chapters than [K]. [K] has the division into processes, and syllabus , on the oher hand, contains no stable division into machines, processes and examples of the calculations. Therefore all calculations in all " hoofdstuken" can't be found in [K]. [K] gives more general information by means of the figures, tables and the practical examples.

4.1. Description of the chapters of the syllabus Deel 3 and the general comparison to [K]

Hoofdstuk 1 : Inleiding

In this chapter is given table with "produktieschema". About this subject is discussed in [K] in the General Intriduction – table 2; in the introduction of part 3. Forming and Shaping Processes and Equipment.

Hoofdstuk 2 : Het stansen

In this article is presented the "principe van het stansen" This chapter is similar to the chapter 16. Sheet – Metal Forming. In [K], the section 16.1. Introduction and 16.2. Shearing is given the general introduction; and on the figure 16.2. schematic illustration of shearing with punch and die.

1.Snijstempel
In this part is given the illustrative explanation matching the section 16.2.4. in [K]. Other methods of cutting sheet metal are on the figure 16.9. of [K].

2.Stempelhuis
This part is explained by illustration. In [K] is dicussed the corresponding part in the section 16.2.4..

3.Inlegstempel
In [K] is given the explanation only in the section 16.2.4.. Other methods of cutting sheet metal are on the figure 16.10.

4.Volgsnijstempel
There is given the general explanation of this machine. In [K] is not corresponding section.

5.Afkantstempel
Also this part is not presented in [K].

6.Compleetstempel
7.Staalbandstempel
8.Messtempel
9.Fijngereedschap
10.Vervaardigen v. gereedschappen
All these machines are not explained in [K]. The economics and the discussion about cost is in the section 16.19. Economic of Sheet – Metal Forming.

11.Snijspleet
12.De snijder
13.De snijplaat
These parts have a brief explanation in the section 16.2. of [K].

14.Strookindeling
15.Afvalpercentage
In [K] are not presented corresponding calculations and tables.

16.De plaats van de inspantap
17.De snijkracht en afstroopkracht
In [K] are presented only the calculations of cutting forces and energy in part 4, chapters 20–24.

Hoofdstuk 3 : Dieptrekken

1.Dieptrekken met plooihouder
In this part is given "schema dieptrekken" and some basic equations and the calculations. The similar sections of [K] are 16.9. Deep Drawing; 16.9.1. The Process; the figure 16.32 with shematic illuctration of a deep–drawing process. The basic equations and calculations are given in [K] in the section 16.9.2..

2.De trekspleet
3.De trekmatrijsafronding
4.De trekstempelafronding
5.De trekken zonder plooihouder
6.Verschilende matrijsvormen

7.Platineafmeting cylindrische produkten
8.Toepassing van de regel van Guldin t.b.v. platine afmeting
9.De diepkracht
10.De plooihouderkracht
11.Dieptrekarbeid
12.Totale arbeid per slag
These parts don't have any corresponding sections in [K], only the section 16.9.3. gives more information about Deep–drawing practice.

Hoofdstuk 4 : Het duntrekken

This section is not presented in [K], some of these information are given on figure 16.26.

Hoofdstuk 5 : Massief omvormen

1.Voorwaatse stafextrusie
The extrusion is presented in chapter 25. of [K]. There is given in15.1. Introduction; 15.2. The extrusion Process; 15.2.1. Extrusion force in hot extrusion.

2.Achterwaatse hulsextrusie
In [K], the section 15.3. is given the Extrusion Praktise; 15.4.Hot Extrusion, 15.5. Cold Extrusion; 15.6. Impact Extrusion; 15.7. Hydrostatic Extrusion.

3.Hobben
4.Het "drukbergverschijnsel"
5.Krimpringen
6.Conische krimpringen
7.Een andere methode is het wikkelen van draad of band onder voorspanning
8.Mantel wikkeling van band
The information matching with these parts are in [K] only in the section 15.9..

Hoofdstuk 6: Keuze van gereedschappen

In the part 2 of [K] are given plenty of tables with all kind of properties of materials. In the chapter 5 are they: teb. 5.9.; 5.8.; 5.5.; 5.4.; 5.1..

Hoofdstuk 7 : Procesindeling naar geometrie

In this section is given a general division of processes. Same subject can be found in [K] in the introduction of part 3 Forming and Shaping Processes and Equipment; table III.1. the general characteristics of forming and shaping processes; the section 17.5. Secondary and Finish Operations.

*Kracht–weg diagrammen
*Proces indeling naar het verloop van de kracht
This subject division structure is not found in [K]. Each process description of [K] contains also description of forces in the following sections: 13.2.2.; 14.2.1.; 14.3.3.; 15.2.1.; 16.2.1.; 16.5.4..

Hoofdstuk 8 : Omvormmachines algemeen

In [K] is not corresponding chapter, but each process has in the subsection the description of equipment.These sections are followig : 13.4.; 13.7.1.; 14.9.;14.9.1.; 14.9.2.; 15.9.; 16.18..

2.De ketting–trekbank
In [K] is the description in the section 15.11. Drawing Practise; on the figure 15.22.; in the section 15.13.; and on the figures 15.28. and 15.29..

3.Primaire kenmerken van persen
3.1.Kracht
3.2.Arbeid
3.3.Stijfheid
Presses are described in [K] in the section 14.9.Forging Machines; 14.9.1.; 14.9.2.; and in the section 14.9.3. Selection of Forging Machines.

4.Verdeling toegevoegde arbeid
This section is described in [K] in 14.11. Economics of Forging.
*Het slaan van een penning
In the section 14.3.2. of [K] is described Coining, on the figure 14.10.; and in 14.3.3. Forging force calculation.

5.Secundaire kenmerken
5.1.Stotersnelheid
5.2.Contacttijd
5.3.Slagbegrenzing
5.4.Produktiesnelheid
These parts don't have similar chapters in [K], the cost in forging is discussed in 14.11. Economics of Forging. The presses are discussed in 14.9.1..

Hoofdstuk 9 : Hydraulische pers

1.Inleiding
Hydraulic presses are generaly described in the section 14.9.1. and 15.9..

Hoofdstuk 10 : Mechanische persen

1.Krukpers–analyse van de stoterbewerging
2.Stoter–weg, snelheid en versnelling
3.Stoter–snelheid en versnelling
4.Analyse v/d stoterbewerking

5.Krukpers–analyse van de krachten
6.Persveilingen
7.Kracht F en $F_{max\ frame}$ als functie van de krukhoek met λ als parameter
8.Kracht F en $F_{max\ frame}$ als functie van de stoterweg met λ als parameter
9.Krukpers–analyse van de krachten
10.Krukpers–analyse van de krachten
11.Excenterpers–analyse van de krachten
12.De kniehefboompers
13.Vliegwiel–energie
14.Krukpers–arbeid
15.Keuze van een mechanische pers

The mechanical presses are described in the section 14.9.1., this section is general and doesn't contain the same subject division as parts 1–15 in syllabus.In the section 14.9.3.is given the selection of forging machines, corresponding with part 15 of syllabus. The section 14.10. describes Forging in Practise and Process Capabilities.

5. PART : METEN EN CONTROLEREN , written records from the lecture

The part "Meten en controleren" contains the following main parts:

1. Meten en controleren
2. Meten is weten
3. Verwerking toevallige afwijkingen
4. Mechanische metingen
5. Nauwkeurig meten van lengte en hoek in twee dimensies
6. 3D–Meettechniek
7. Temperatuursmeting, krachtmeting, massameting
8. Rondheidsmeting
9. Ruwheidsmeting

Only a part of the corresponding contents of this lectures can be found in [K] , mainly in the part 7, and 6. Since there is very big diferrence between the lectures and [K], I will list mostly the written records from the lectures and immediately after that the corresponding sections of [K] with location numbers. The part 2 and 3 will be treated together, and also part 4 and 5 of [K].

number of lecture part **characteristics of fitting with [K]**

1 The big diferrence, the lecture discribes the general methods of measurements, measurement systems, [K] discribes the specific inspections. Also the standards SI are not in [K] estabilished.

2 [K] is devided into a diferrent sections.

3 [K] doesn't contain the general description of the problem.

4 [K] doesn't contain the general description of methods, of the terms like strightness, flatness.

5 In [K] is not presented the division into 1D and 2D metrology.

6 [K] in the section Fits describes American National Standards

7 In [K] is no corresponding section.

8 [K] doesn't contain the mathematical description.

9 Only a general problems are corresponding in [K], more is not presented.

***1* Meten en controleren**

In this lecture was given the general introduction of the following statements:
-metrologie (onderdelen)
-hoofdgebieden meettechniek
-wat is meten
-materialisatie van het meetproces
-SI, combinaties SI eenheden, erkende niet SI eenheden
-ideaal meetproces-systematische, toevallige afwijkingen
-reeel meetproces-direct, indirect, nulmethode, uitslagmethode, substitutie meetmethode, differentie meetmethode
-nadere beschouwing meetsystem: analoog, digitaal, absoluut, incrimenteel, sensortypen, signaalbehandeling
-veel voorkomende begrippen : resolutie, lineariteit, gevoeligheid, aanspreekwaarde, nulpuntsdrift, gevoeligheidsdrift, hysterese

In [K] is given, in part 6 Surface technology, the introduction, which contains the general outline of topics of surface technology. In the chapter 35 Engineering Metrology in 35.1. Introduction is a general explanation of the term metrology, inspection, dimensional tolerances. Also in part 7 , in the introduction are given some general knowledges of this subject. In the section 35.2. Measurement Standards is covered the standard of meter and discussion about inch, foot; there is also description of the term sensitivity. The section 35.3. describes Line-Graduated Instruments, 35.3.1. Linear measurement (direct reading), 35.3.2. Linear measurement (indirect reading), 35.3.3. Angle measurement instruments, 35.4. Comparative Lengh-Measuring Instruments, 35.4.1. Dial indicators, 35.4.2. Electronic gages, 35.5.6. Optical projectors. In the introduction of the chapter 36 Testing, Inspection, and Quality Assurance is given the explanation of the term product quality.

***2* Meten is weten**

In this lecture was given the following:
-statistische nauwkeurigheid van het meetproces
-systematische afwijkingen, dynamische systematische afwijkingen

–vaststellen syst. afwijking meetinstrument : via kalibratie tegen standaard
–kalibratie door NKO–erkende lab's
–vaststellen syst. afwijkingen ontstaan via externe bronnen, maximale systematische afwijking, relative syst. afwijking
–voorbeelden

***3* Verwerking toevallige afwijkingen**

onderscheid–toevallige afwijkingen, onbekend systematische afwijkingen
–spreiding van meetuitkomsten
–analyse van het verloop van de spreiding
–histogram
–model van Gauss, "student" benadering, "f–verdeling" uitzetten, "x–test"
–werkwijze bij enkelvoudige metingen

The sections of [K] discribing the similar subjects are the following:
part 7,chapter 36,section 36.7. Statistical methods of Quality Control; 36.7.1.
The section 36.8. Statistical Process Control; 36.8.1.; 36.8.2..
The section 36.9. Acceptance Sampling and Control; the section 36.10 Total Quality Control. The section 36.11. Quality Engineering as a Phylosophy; the section 36.12 Reliability.

***4* Mechanische metingen**

–het meten van lengte en hoek
–keuze juiste meetmiddelen
–meten van lengte en hoek in de werkplaats
–meten van lengte : schuifmaten, sensorprincipes schuifmaten, capacitief
–Schroefmaten,tandwiel meting, schroefmaten voor binnenmetingen
–meetkracht: sensorprincipes, kalibraties, pneumatische sensoren
–verplaatsingsopnemers voor kleine en middelgrote verplaatsingen
–mechanische en electronische opnemers voor verplaatsingmeting

–opto–electronische opnemers
–toepassing van eindmaten
–hoekmetingen
–rechtheidsmeting met waterpas
–vlakheidsmeting via rechtheidsmeting

***5* Nauwkeurig meten van lengte en hoek in een en twee dimensies**

–1D–lengte meettechniek, meetschema's, laserinterferometer, hoogtemeter
–2D–tweedimensionale meettechniek, meetmicroscopen, basis schema
2D–meetmachines, meetprojector.

The similar sections of [K] :
part 7 ,chapter 35 Engineering Metrology; 35.3.; 35.3.1.; 35.3.2.; 35.3.3.; 35.4.; 35.4.1.; 35.4.2.; 35.5.5.; 35.7.; 35.7.1.; 35.7.2.; 35.7.3.; 35.5; 35.5.1.; 35.5.2.; 35.9.; 35.10..

***6* 3D–Meettechniek**

–principe
–aerostatische geleidingen, typen motoraandrijvingen
–tastsystem
–computer koppeling
–automatisch meten
–meetnauwkeurigheid–storingsbronnen

The corresponding sections of [K] :
part 7, chapter 35, section 35.6. Coordinate Measuring and Layout machines; sections 35.11.1.; 35.11.2; 35.11.3.

***7* Temperatuursmeting, krachtmeting, massameting**

-temperatuursmeting: eenheid, meetinstrumenten voor IPTS-68/ITS-90, meetmiddelen, electrische thermometers, stralingsthermometrie, optische pyrometers
-krachtmeting: algemene methode, versnellingsmeting, mechanisch aanbrengen van F via balans, LVDT, dynamische krachtmeting met evenwicht, rekstroken, ringkrachtmeter
-massameting: eenheid, standard, wegwn, analyse balans, weegtechniek, wegen grote massa's

This section doesn't have any corresponding section in [K].

***8* Rondheidsmeting**

-meettechniek zonder meetmachine, met meetmachine,
-meetmachine : met externe rotatie as, draaiende tafel, draaibare taster
-kalibratie
-rondheid analyse, Fourier analyse

In [K] is short explanation in the section 35.5.3.

***9* Ruwheidsmeting**

-tastermethoden, filtering, meetvoorschriften
-keuze van de basisgolflengte
-numerieke waarden,
-digitale, optische ruwheid

In [K] are the corresponding sections :
part 6, chapter 31, section 31.5.Surface Roughness; 31.5.1.; 31.5.2.; 31.5.3.; 31.5.4..
Also the sections 31.1.; 31.2.; 31.3.; 31.4..