

Vehicle Manufacturing I

Code: MK3JGY1J08JJ20-EN

ECTS Credit Points: 8

Evaluation: exam

Semester: 5th semester

Its prerequisite(s): Vehicle Materials and Technologies

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+6

Topics:

Structure and kinematic analysis of machine tools in vehicle manufacturing. Application of CNC machining centres in production planning. Analysis of mechanical properties of different vehicle materials. Production of various vehicle profiles (cutting, punching, bending, deep drawing, etc.). Design of technological parameters and machining tool geometries. Manufacturing technologies for body parts. Assembling parts made by different technologies into parts by welding, riveting and gluing. Welding technology during the assembly of body elements (gas welding, arc welding). Thermal cuts. Metal spraying, plasma spraying. Adhesives used in the construction of vehicles. General introduction to robotics. Theoretical background of robotics. Conceptual definition and classification of robots. Robot Architecture, Coordinate Systems, Robot Workspaces, and Restriction of Workspaces. Structure of robots, operation of robots. Mechanical structure of robots, characteristics of mechanical structure, kinetic chains, forced equations. Manual control of robots, demonstration of basic forms of motion. Robot gripping structures, relation between gripping safety and robot kinetic characteristics. Robot programming and information processing, principles of robot programming, basic concepts of programming. Basics of Robot Programming. Description of Robot Movements in Program Languages General Principles of Path Generation, Questions of Linear and Curved Paths, Linear Interpolation, Circular Interpolation. Determination of robot position and orientation, position movements and orientation movements. Application and design of robots. Material handling applications, combined application of technology and material handling systems, synchronization tasks. Introducing the Smart Space concept: robots in human spaces. Robot simulation.

Literature:

Compulsory:

- Shage, E.: Machining and CNC Technology, The McGraw-Hill, 2014., ISBN 978-0-07-337378-2
- Taylan, A., Tekkaya, E.: Sheet Metal Forming: Fundamentals, The Ohio State University, USA, Technical Univeristy Dortmund, Germany, 2012., ISBN: 978-1-61503-842-8
- Taylan, A., Tekkaya, E.: Sheet Metal Forming: Processes and Applications, The Ohio State University, USA, Technical Univeristy Dortmund, Germany, ISBN: 978-1-61503-844-2
- Groover, M. P.: Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson; 4th edition (January 8, 2015), ISBN: 978-0133499612
- Altintas, Y.: Manufacturing Automation: Metal Cutting Mechanics, Machine Tool Vibrations, and CNC Design, Cambridge University Press; 2nd edition (January 16, 2012), ISBN: 978-1107001480

Schedule

1st week Registration week

2nd week:

3rd week:

Lecture: Introduction to Machining, Layout Skills and Tools, Cutting Tool Geometry, Drilling and Operations and, Turning Operations, Mills and Milling Operations, Precision Grinding Operations and, Screw Thread Technology, Computer Numerical, Coordinates, Axes, and Motion, CNC Systems, CNC Controls, operating a CNC Machine, Program Planning, Setting Up a CNC Machine

Practice: Laboratory practice, shopfloor, drilling, turning, milling, basics of CNC operations

4th week:

Lecture: Metal Forming Processes in Manufacturing, Classification of Manufacturing Processes, Characteristics of Manufacturing Processes, Metal Forming Processes in Manufacturing, Classification of Metal Forming Processes

Practice: Laboratory practice, Metal Forming Processes in Manufacturing, Classification of Metal Forming Processes

6th week:

Lecture: Mechanical Presses, Electro Mechanical Servo Drive Presses for Sheet Forming, Hydraulic Presses

Practice: Mechanical Press Designs, Characteristic of Mechanical Presses, Other Features of Mechanical Presses, Servo Press Drives, Applications

8th week: Mid-term test

9th week:

Lecture: Introduction to robotics, Basic Elements of an Automated System, Levels of Automation

Practice: Laboratory practice, basics of robotics, main parts of robot manipulators

11th week:

Lecture: Discrete Control and Programmable Logic Controllers

Practice: Laboratory practice, basics of PLC programming, robot programming

Lecture: Design and Analysis of CNC Systems, Machine Tool Drives, Mechanical Component and Torque Requirements, Feedback devices, Electrical Drives, Position Control Loop

Practice: Laboratory practice, shopfloor, drilling, turning, milling, basics of CNC operationsclutches; transmission actuators. Special transmissions: CVT, DCT, toroid.

5th week:

Lecture: Classification and Description of Sheet Metal Forming Operations, Sticking and welding

Process Variables, Sheet Metal Forming as a System, Brief Description of Sheet Metal Forming Operations

Practice: Laboratory practice, Process Variables, Sheet Metal Forming as a System, Classification of Geometries

7th week:

Lecture: Blanking, Bending, Flanging and Hemming, Warm Forming, Hot Stamping, Sheet Hydroforming, Tube Hydroforming, Roll Forming

Practice: Blanking Process, Tool Materials, Mechanics of Bending, Other Industrial Bending Processes, Bending Machines, Roll Forming Lines, Roll Design, Materials for THF

10th week:

Lecture: Hardware components for automation and process control, Industrial Robotics

Practice: Laboratory practice, basics of robotics, main parts of robot manipulators

12th week:

Lecture: Material Handling and Identification, Material Transport system

Practice: Overview of Material Handling, Material Transport Equipment, Analysis of Material Transport Systems.

13th week:

Lecture: Storage Systems and automatic identification data capture

Practice: Definition of Storage Systems, Conventional Storage Systems, Automated Storage Systems

14th week:

Lecture: Inspection principles and practice, Artificial Vision in manufacturing, Industry 4.0 principles.

Practice: Automated inspection with robotics and AI, Analysis of inspection system, Case Studies

15th week: End-term test**Requirements****A, for a signature:**

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence due to the lack of active participation in class.

During the semester there is some homework related to each topic and there are two tests: the mid-term test is in the 7th week and the end-term test in the 15th week. Conditions for the signature:

- to reach the 50 % score on both tests.
- to hand the homework in time.

B, for a grade:

The course ends with a **mid-semester grade (AW5)**. During the exam period there is another test on all the topics of the semester. This test is accepted with minimum 50 % score. The total score of the semester is the sum of the scores of all tests (mid-term, end-term, exam) and the homework tasks, and the grade is given according to the following table:

Score	Grade
0-99	fail (1)
100-129	pass (2)
130-159	satisfactory (3)
160-179	good (4)
180-200	excellent (5)