Materials Technology and Testing

Code: MK3ANTVG05GX17-EN

ECTS Credit Points: 5

Year, Semester: 1st year, 2nd semester

Its prerequisite(s): Materials Engineering

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+3

Topics:

Definition and classification of technological processes applied for engineering materials. Basic principles of heat treatment. Hardening, tempering, annealing. Surface heat treatment (case hardening), thermo-chemical treatment (nitriding). Joining technologies and their applications. Classification of welding, the major welding technologies. Heat sources, filler materials, machines for different welding technologies. Arc-welding processes, resistance welding, pressure welding, high energy welding, etc. The fusion welded joint. Application fields of the various welding processes. Material testing. Destructive testing methods Introduction to non-destructive testing (NDT) methods (visual, radiographic, ultrasonic, magnetic, eddy current, dye penetrant, acoustic emission, etc.). Physical principles and areas of application. Flaw detection and sizing. Automation of NDT processes. The performance and evaluation of various laboratory tests (tensile, fracture mechanics, hardness). Metallography and relevant testing methods.

Literature:

Compulsory:

- William D. Callister, David G. Rethwisch: Fundamentals of materials science and engineering : SI version, John Wiley and Sons, 2013., ISBN 978 1 118 32269 7
- Hellier, Chuck: Handbook of Nondestructive Evaluation, 2nd Edition McGraw-Hill, 2012, ISBN 9780071777148
- Mikell P. Groover: Principles of modern manufacturing : SI version, Wiley, 2013, ISBN: 9781118474204
- James L. McCall, William M. Mueller ed.: Metallographic specimen preparation: optical and electron microscopy, Springer, 2012, ISBN 9781461587101

Schedule

1st week Registration week	
2nd week: **Lecture:** Introduction to manufacturing and manufacturing processes. Production Systems **Practice:** Introduction to safety laboratory work. Introduction to basic welding processes.	**3rd week:** **Lecture:** Overview of Welding Technology. The Weld Joint. Physics of Welding. Features of a Fusion-Welded Joint. Types of Arc welding: **Practice:** Are welding
4th week: **Lecture:** Energy Beam welding. (laser, electron beam, plasma) Oxyfuel gas welding. Solid state welding. Resistance Welding	**5th week:** **Lecture**: Other Fusion-Welding Processes. Solid-State Welding. Weld Quality. Weldability. Machines of welding technology.

Practice: Oxyfuel gas welding.	**Practice:** Gas tungsten arc welding (GTAW)
6th week:	7th week:
Lecture: Direct Hardening: Annealing methods: full annealing, stress relief annealing. Austenitizing and quench, selective hardening.	**Lecture:** Surface heat treating process: carburizing, nitriding, carbonitriding. Equipment for heat treating operations
Practice: TTT diagrams - Microstructural determinations for isothermal heat treatments	**Practice:** Heat treating method for steel.
8th week: 1st drawing week	
9th week:	10th week:
Lecture: Destructive testing methods: Mechanical properties of metals. Concepts of stress and strain. Elastic, plastic deformation.	**Lecture:** Destructive testing methods: Comparison of materials harnesses. The difference between the theoretical and practical strength of the materials and their reason.
Practice: Tensile Testing. Computation of Load to produce specified diameter change.	**Practice:** Hardness test methods.
11th week:	12th week:
Lecture: Charpy impact test. Crack theory: Fracture mechanism, Failures.	**Lecture:** Metallographic examination of metals. Interpretation of metals microstructure. Specimen preparation process.
Practice: Charpy impact tests.	**Practice:** Optical microscopy investigations.
13th week:	14th week:
Lecture: Non-destructive testing methods: visual, radiographic, ultrasonic, magnetic, eddy current, dye penetrant, acoustic emission.	**Lecture:** Microscopic Examinations: Scanning electron microscopy, EDS-Energy Dispersive Spectroscopy
Practice: Non-destructive testing.	**Practice:** SEM examination.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the lectures is recommended, but not compulsory. Participation at practice is compulsory. Student must attend the practices and not miss more than three practices during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student can't make up a practice with another group. The attendance on practice 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.

During the semester there are two tests: the mid-term test is in the first drawing week and the end-term test in the 2nd drawing week. Students have to sit for the tests. If the score of any test is below 60%, the student once can take a retake test covering the whole semester material.

B, for grade:

The course ends in a state exam, the grade is calculated as:

- 60% from the exam
- 20%-20% from the two tests

The minimum requirement for passing is 60%, the grade for the final mark is given according to the following table:

Score	Grade

0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)