Department of Materials Science and Engineering

Project Assignment Requirements

MŰEGYETEM 1782

PROJECT ASSIGNMENT REQUIREMENTS

Student Information

The purpose of the project assignment is not to reproduce a ready-made solution, but to demonstrate that the student can select a material and suitable manufacturing and heat-treatment processes for a metal product or component based on engineering considerations, and can briefly justify the decision in professional terms.

> **Important:** the examples illustrate the expected standard of the submission. The example products are not part of the assignment list distributed to students.

1. General Submission and Oral Presentation Requirements

a) Project Assignments I and II each consist of two independent tasks.
b) Each solution may be no longer than 1 page. Accordingly, the complete submission for Project Assignments I and II may be no longer than 2 pages each.
c) At the end of each laboratory session, the laboratory instructor provides 5 minutes for students to consult about their assignments.
d) The assignments must be submitted in printed form at the beginning of the designated laboratory.
e) The student has no more than 5 minutes to present the assigned problems and the solution; the instructor may ask brief questions about the submitted work.
f) The aim of the oral presentation is to verify independent work and understanding.
g) The solution must be concise, clear, and follow sound engineering logic. Decisions must be justified rather than merely listed.
h) The datasheets, standards, course notes, or other technical sources used must be cited in the submission.
i) The project assignment contributes to the final course grade:

Grade = 70% of the exam + 30% of the project assignment

> **A make-up assignment is required** if the total score for either project assignment (comprising two problems each) is below 40% of the maximum: at least 4/10 points are required for Project Assignment I and at least 8/20 points for Project Assignment II.
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> **A make-up assignment may be submitted** free of charge within 1 week of the original submission date. In the week following the assignment submission, the laboratory instructor will provide a time (outside the course timetable, so a conflict may occur) to meet the students in person.

The *Material Selection Guide* contains tables based on current standards for quenching and tempering steels, case-hardening steels, and tool steels. The project assignments may also involve other material groups. For example, without claiming completeness, datasheets for corrosion-resistant steels, aluminium alloys, and other light and non-ferrous metals must be found online.

2. Project Assignment I – Material Selection

Project Assignment I consists of two material-selection problems. For each problem, an appropriate material group and a specific material grade must be selected for a particular metal product or component, and the selection must be justified.

Assessment criterion	What must be demonstrated?
Appropriate material group and specific material grade	The material group and the selected standard material designation must be consistent with each other.
Technical justification	At least two relevant considerations: loading, service environment, manufacturing/economic requirements, size, hardness, formability, etc.
Consistency, understanding, and brief oral presentation	The complete solution must be technically consistent. The student must understand and be able to justify the decision.

Suggested Structure for a Project Assignment I task

1. Brief statement of the problem and the specified boundary conditions.
2. Selected material group.
3. Specific material grade.
4. Approximately 2–4 sentences of justification linking the boundary conditions to the material properties.
5. Citation of sources.

Pre-Submission Checklist

☐ I answered the assigned problem rather than writing a general overview.

☐ The selected material group and material grade are consistent with each other.

☐ In my justification, I explicitly identified at least two technical considerations that follow directly from the problem.

☐ I cited the sources used (datasheets, textbooks, lecture slides, and links).

☐ I can briefly explain the solution in my own words.

☐ Neither task exceeds 1 page.

3. Project Assignment I – Sample Problem and Sample Solution

Name: Bicycle U-lock

Task statement: the Ø16 mm U-shaped load-bearing element of a bicycle U-lock designed for outdoor use. Produced in large quantities.

Material group: alloy steel for quenching and tempering (ISO 683-2:2016).

Material grade: 42CrMo4

Justification:

- During an attempted forced opening, the load-bearing element of the U-lock may be subjected to severe bending, tensile, and impact loads. It therefore requires high yield strength, tensile strength, and adequate toughness. In the quenched-and-tempered condition, 42CrMo4 meets these requirements and is less brittle than a tool steel selected solely for high hardness.
- According to the guide, for diameters up to Ø16 mm, the 0.2% proof strength of 42CrMo4 is at least 900 MPa and its tensile strength 1100–1300 MPa. This provides adequate resistance to permanent deformation (bending) and fracture of the lock.
- The material is available as standard round steel and can be formed and heat-treated in series production.
- Because it is not corrosion-resistant, a coating is required for outdoor use; however, this is more economical than using corrosion-resistant steel.

Sources used:

1. Material Selection Guide – ATT
2. https://bikemag.hu/wp-content/uploads/2023/07/002161_1022.jpg (accessed: 2026.08.04.)

4. Project Assignment II – Manufacturing Technology and Heat Treatment

Project Assignment II comprises two problems with a specified product and material grade. Students must identify the material group, select a suitable manufacturing route and heat treatment, and prepare an accurately labeled temperature–time diagram.

Assessment criterion	What must be demonstrated?
Identification of the material group	Correct classification of the specified material grade.
Manufacturing technology	Logical sequence of the starting semi-finished product and essential forming/machining operations.
Written description of heat treatment	Required heat-treatment operations in the correct sequence, with their purposes.
Heat-treatment diagram	Clear labels for temperatures, times or ranges, cooling methods, and operation names.
Consistency, understanding, and oral defense	The process route must be feasible and consistent. The student must understand and justify the decisions.

Suggested Structure for a Project Assignment II Problem

1. Concise statement of the problem and the specified boundary conditions.
2. Identification of the specified material's material group.
3. Starting semi-finished product and sequence of manufacturing operations.
4. Purpose and operations of the heat treatment.
5. Temperature–time diagram including all important data.
6. Citation of sources.

Pre-Submission Checklist

☐ I identified the assigned material's material group.

☐ The manufacturing route is traceable from the starting semi-finished product to the finished component.

☐ I described the heat-treatment steps and their purposes, and labeled the diagram completely.

☐ I cited sources for the temperatures and other process data.

☐ I cited all sources used (datasheets, textbooks, slides, and links).

☐ I can briefly explain the solution in my own words.

☐ Neither task exceeds 1 page.

5. Project Assignment II – Sample Problem and Sample Solution

Name: Passenger-car anti-roll bar

Material: 51CrV4

Task statement: nominal diameter Ø22 mm, produced in large quantities. It is subjected to repeated torsional and bending loads, so high fatigue strength and adequate toughness are required.

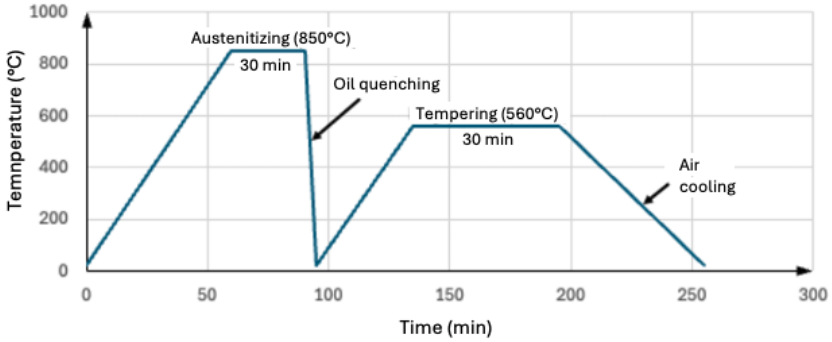
Material group: according to ISO 683-2:2016, **alloy steel for quenching and tempering.**

Manufacturing:

- Starting product: round steel – coiled rod, because it is produced in large quantities (Ø23 mm, h11, thesteel.com).
- Cutting to the required length.
- Hot flattening/forging of the connecting ends; uniform heating followed by three-dimensional forming in a fixture or on a multi-station bending machine. The fixture controls the arm length, bending radius, and symmetry. Burrs and sharp transitions must be removed because of the risk of fatigue cracking.
- Forming the holes and other end geometries by pressing or machining.

Heat treatment:

- Quenching: austenitizing at 850°C (specified range: 820–860°C), holding for 30 minutes, followed by oil quenching. Purpose: to produce a high-strength martensitic microstructure.
- Tempering: immediately after quenching, holding at 560°C for 60 minutes, followed by air cooling (specified range: 540–680°C). Purpose: to reduce the brittleness caused by martensite and provide high strength with adequate toughness.



Sources used:

1. Material Selection Guide – ATT
2. https://www.thesteel.com/hu/v/121337 (accessed: 2026.08.04.)
3. https://icmagazin.hu/storage/Anti/Ro/Anti-Roll-Bar.jpg (accessed: 2026.08.04.)

> In your own assignment, temperatures, holding times, cooling medium, and the sequence of operations must be specified using a source applicable to the particular material and cross-section.