

**Master Examination**  
**„Materials Science of Steel“**

**Part 2**

**“Steel Design”**

**27<sup>th</sup> Aug. `12**

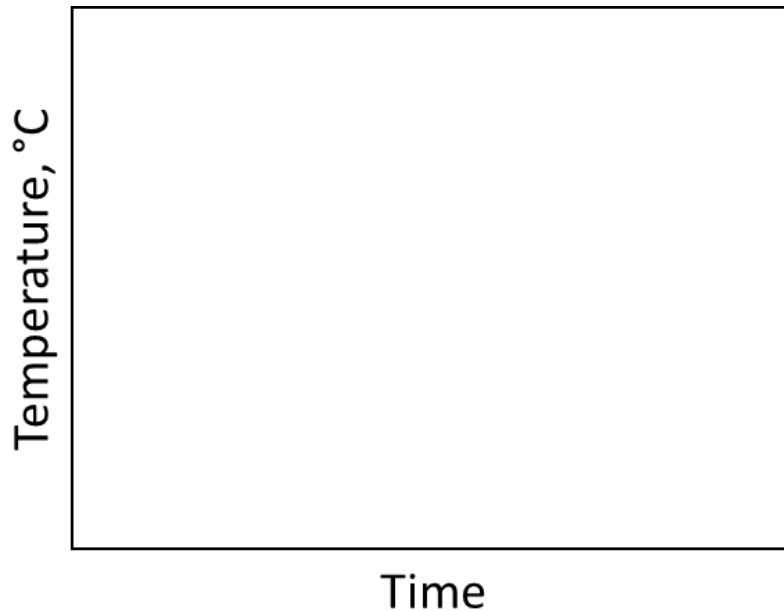
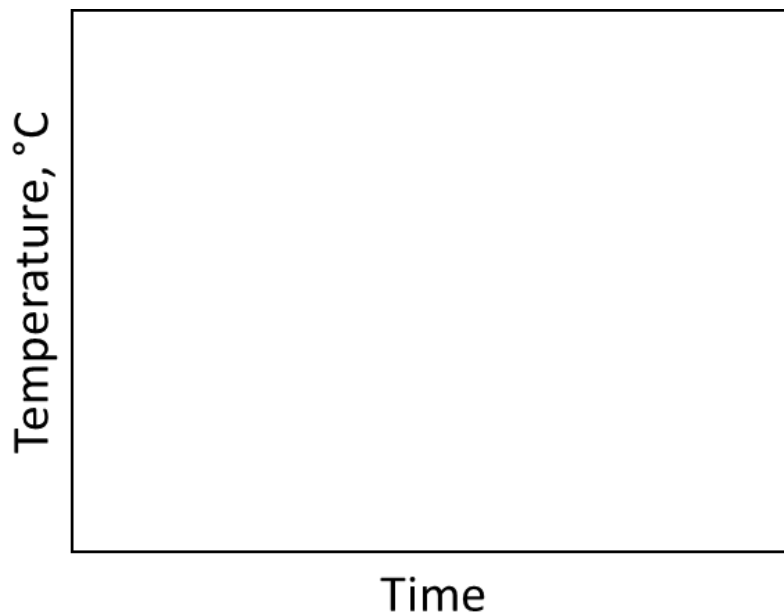
**Name:**

**Matriculation number:**

Question	Maximal erreichbare Points:	Erreichte Points:	Einsicht: (nur neue TeilPoints angeben, <b>nicht</b> neue Gesamtpunktzahl pro Question)
Part I / 1-14	70		
15	4,0		
16	1,0		
17	2,0		
18	2,0		
19	2,0		
20	1,0		
21	4,0		
22	1,5		
23	0,5		
24	2,5		
25	2,0		
26	1,0		
27	2,0		
28	3,0		
29	1,5		
Summe	100		

**Aufgabe 15****Steel Design – AHSS (Bleck)****4 Points**

Using a TTT-diagram, show schematically the hot rolled strip and the cold rolled strip production of a DP-steel. What is the microstructure before cooling? (4P)

**Hot rolled****Cold rolled**



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**Aufgabe 16** **Steel Design – AHSS (Bleck)** **1 Points**

In Dual Phase steels, there is usually 5 to 30 vol.-% martensite present in the microstructure. Explain the lower and the upper limit of the martensite content on the base of the mechanical properties. (1P)

**Aufgabe 17****Steel Design – AHSS (Bleck)****2 Points**

The special properties of TRIP-steels are related to the presence of approximately 10% retained austenite in the microstructure. Explain what it makes possible to have retained austenite present in a 0.2 wt.-% C steel. Is the retained austenite thermodynamically stable? Is it mechanically stable? (2P)

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**Aufgabe 18** **Steel Design – HSS (Kern)** **2 Points**

Why is the treatment of the crude steel in the secondary metallurgy and especially the treatment of the sulfide shape of great importance for the production of heavy plates? How is the sulfide shape typically modified? (2P)

**Aufgabe 19****Steel Design – HSS (Kern)****2 Points**

Nowadays, there are have high requirements on steels for pipelines regarding the resistance against HIC of. What does HIC mean and which aspects shall be considered in the alloying content and the degree of cleanness of the steel grade, in order to obtain high resistance against HIC? How are linepipes typically manufactured? (2P).

**Aufgabe 20**

**Steel Design – HSS (Kern)**

**1 Points**

How are steels for ship constructions manufactured? What yield strengths shall these steels possess? (1P)



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**Aufgabe 21** **Steel Design – HSS (Kern)** **4 Points**

- a) Which physical-metallurgical mechanisms determine the microstructure development during rolling and heat treatment of high-strength structural steels? (2)
- b) Which mechanism allows blocking the recrystallization in austenite? (1P.)
- c) Name two of usually used alloying elements, which have an effect on the blocking of the recrystallization! (1P)

**Aufgabe 22                      Steel Design - Creep resistant steels                      1.5 Points**

Starting from which operation temperature high temperature resistant materials have to be used? What are the physical reasons for this in steels?

**Aufgabe 23**                      **Steel Design – Creep resistant steels**                      **0.5 Points**

Which method is used to guess the life time of parts under complex mechanical and thermal load? (0,5P)

**Aufgabe 24                      Steel Design – Creep resistant steels                      2.5 Points**

Name the mechanisms which can be used to increase the strength of high-temperature alloys! (2,5P)

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**Aufgabe 25** **Steel Design – Rail Steels (Mu)** **2 Points**

Talking about rails, there are two factors that determine the life time, according to the field of application. Name these two factors, explain what leads to their occurrence and give an example for the fields of application they are used. (2P)

**Aufgabe 26** **Steel Design – Tube steels** **1 Points**

Which are the most relevant process steps in the production of longitudinal seam-welded pipes? Name two of them.

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**Aufgabe 27** **Steel Design – Tube Steels** **2 Points**

What is the first basic processing step used in the production of seamless tubes broadly called? Name three typical processes that use this basic step.

**Aufgabe 28** **Steel Design – Powerplant steels** **1.5 Points**

Which chemical element is mainly responsible for oxidation resistance of ferritic/martensitic steels for power plants? (1,5P)



**Aufgabe 29****Steel Design – EDDS****3 Points**

In cold rolled batch annealed steels the preferred “pancake” microstructure is obtained.

- a) What is a pancake-microstructure? (1P)
- b) Which process parameters lead to the formation of such microstructure? (2P)