# Advanced Master Course

**Process Technology of Metals**

*(Part: Ferrous Process Metallurgy)*

**Prof. Dr.-Ing. D. Senk**

09-02-2010  
*(1/2010)*

Hörsaal H201, Intzestraße 3, IME

**Time:** 14:00-16:00

<table>
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<th>Task</th>
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**Total:** 25

**Total after approval:**
Task 1: Pelletizing and Sintering 3 Points

1.1 Pellet production can be divided into 3 distinct stages:
   
   Stage 1 – Preparation of raw materials
   Stage 2 – Formation of green pellets
   Stage 3 – Firing of green pellets

   (a) Give the grain size of iron ore to be suitable for pelletizing. (0.5 point)
   
   (b) Give the difference between balling disc and balling drum. (0.5 point)

   (c) What is the main task of the firing step? (0.5 point)

1.2 Sintering may be defined as “the agglomeration of fine particles into lump”

   (a) Which material can be used as a source of heat? (0.5 point)

   (b) Give one advantage and one disadvantage of sintering process. (1.0 point)
Task 2: Blast Furnace 3 Points

2.1 Why is sulphur removal from hot metal much easier than that from raw steel?

(0.5 point)

2.2 Is the direct reduction possible at temperature lower than 1000°C and why?

(1.0 point)

2.2 Define the following terms:

(a) Cohesive zone (0.5 point)

(b) Raceway gas (0.5 point)

(c) PCI (0.5 point)
Task 3: Oxygen Steelmaking 3 Points

3.1 What are the advantages of OBM compared to classical BOF shop? (1.0 point)
   (Give at least 2 items)

3.2 What are the tasks of lime in steelmaking? (1.0 point)

3.3 What are the main factors necessary to obtain low phosphorus in the finished molten steel? (1.0 point)
Task 4: Slags and Fluxes  

4.1 What are the reactions take place between hot metal and slag during desulphurisation? (1.0 point)

4.2 (a) Why CaF$_2$ is sometimes used in iron- and steelmaking processes? (0.5 point)

(b) What is a disadvantage of fluorine? (0.5 point)

4.3 What are the tasks of the ladle top slag? (Give at least 2 items) (1.0 point)

4.4 What happens to steel melt and slag if the slag viscosity increases?

(Give at least 2 items) (1.0 point)
Task 5: Electric Steelmaking  

4 Points

5.1 Give a proper sketch to represent the difference between AC-EAF and DC-EAF.  

(1.0 point)

5.2 Explain the procedure and also write down chemical reactions for generation of foaming slag in electric arc furnace process.  

(1.0 point)

5.3 What are benefits of DRI used in electric arc furnace process?  

(Give at least 2 items)  

(1.0 point)

5.4 How can diminish the consumption of graphite electrodes in EAF-process?  

(Give at least 2 items)  

(1.0 point)
Task 6: Secondary Metallurgy (Ladle Metallurgy) 4 points

6.1 Which gases can dissolved in their atomic state in molten steel? (1.0 point)

6.2 What goals of “Secondary Metallurgy” can be reached by physical measures?
(Give at least 2 tasks) (1.0 point)

6.3 Give equation to represent:
(a) Vacher-Hamilton Equilibrium (0.5 point)

(b) Sieverts’s law (0.5 point)

6.4 What are the following items meaning? (1.0 point)
(a) VD

(b) AOD
Task 7: Continuous Casting (CC)  4 points

7.1 What is the purpose of the mould oscillation during casting?  (0.5 point)

7.2 What are the tasks of continuous casting mould powder?
   (Give at least 2 items).  (1.0 point)

7.3 What is the difference between killed steel and rimming steel?  (1.0 point)

7.4 Give three different types of solidification structure in a cast slab?  (1.5 point)