Test A

1. Mechanical production of molds and cores.

The purpose of machine molding is to eliminate the laborious manual work of ramming molds and cores, to increase labor productivity and improve casting accuracy.
In terms of the molding machine used, ie according to the method of densifying the molding or core mixture, the machine molding can be divided into:

(a) pressing
(b) shaking
(c) trimming with compression
d) blowing with compression
e) metání
f) blowing
(g) firing

In the production of molds the most common methods are **c), d),** eventually **e**), in the case of the production of cores it is mainly the methods **f)** and **g)**.

2. Metals and alloys used in foundry industry.

iron alloy with carbon
Cast iron:
● Gray cast iron with flake graphite
● Ductile iron
● Malleable cast iron
Copper alloys:
● Zinc alloy
● alloys with tin, aluminum, lead
Aluminum alloy:
● Al-Si…. silumins
● Al-Mg…. hydronalia
● Al-Cu
● Al-Cu-Ni

3. Express the mechanical stress of the molds during casting.

When casting metal into the mold, it is necessary to take into account a certain stress of this mold. Basically, we talk about mechanical, thermal and chemical stresses.

Mechanical stress

The mechanical stress of the mold is caused by the metallostatic pressure of the liquid metal, which depends on the level above the mold at which the pressure is measured and on the specific gravity of the melt. The pressure acting in this direction generates in the form the so-called buoyancy, ie the force that tries to lift the top of the mold. If such an uplift occurs, there would be a gap between the top and the bottom of the mold that liquid metal would escape from the mold. Therefore, the mold must be sufficiently secured against the effects of buoyancy so that metal leakage in the separation plane cannot occur.

4. What are the properties of molten metals and alloys.

Foundry properties are technological properties derived from the complex effect of physical properties of metal and mold during casting, casting conditions and casting construction. Collectively, this is called castability, ie the ability to create a healthy casting.

The most important features are:

1) Meltability - ability of metal to move from solid to liquid state
2) Flowability - depends on the relative mobility of the melt particles at a given temperature
3) Run-in - the ability of the melt to fill thin sections in the active mold cavity
4) Shrinkage - volume and dimensional changes in the active mold cavity
5) Degreasing - separation of various structural components during solidification of the melt
6) Solubility of gases - with increasing temperature the solubility of gases in the melt increases, decreases when cooled

5. Explain the physical nature and mechanism of plastic deformation.

The internal forces act against the external forces acting on the body. These internal forces defend the metal of its deformation. The resulting forming effect therefore depends not only on the nature of the external forces, but also on the structure of the molded material. In contrast to elastic deformation, there is a permanent displacement of atoms between them by distances greater than the lattice constant. The most common mechanism of atomic displacement that occurs in whole layers and certain planes is called simple sliding (translation), or twinning. The stress needed to yield at a particular plane is called the critical shear stress τkr = crystallographic yield point. It is the least shear stress required to induce translation

$$\tau_{kr} = \frac{F}{S} cos\varphi . cos\lambda$$

The value of τkr depends on the deformation rate and temperature, and whether the crystal it had been deformed before.

The slip occurs first in those planes where the tangential shear stress caused by the external force reaches τkr. The displacements of the individual crystallographic planes occur gradually as they increase on these planes, due to the increasing effect of the external force, the tangential stress and when it reaches the value τkr.

The formation of plastic deformation is influenced by the atomic structure of the crystal lattice (different types of lattices have different character = different number of possible sliding planes)

6. Describe the influence of temperature on plastic properties of the material.

Influence of temperature - plastic properties (also deformation resistance) varies considerably with temperature. If the structure consists of a single phase, the plastic properties generally improve with increasing temperature. For steels, ductility decreases only in the region of its brittleness under blue heat. However, a further increase in temperature leads to a rapid decrease in strength. The ductility also decreases in the region of temperatures at which incomplete hot deformation is possible and in the region of phase transformations. The last effect is illuminated by the fact that the presence of two phases with different properties leads to an increase in uneven stress. At temperatures close to melting points, the ductility again deteriorates due to overheating (considerable grain coarsening). The same applies to other metals and alloys. The high ductility in the region of the forming temperatures is due to the fact that the number of atomic vibrations increases and the ductility of the intercrystalline layers increases considerably. The intercrystalline layer with more admixtures has a lower melting point than the grain, therefore the decrease in strength at increasing temperature is faster than that of the grains. At the same time, the brittleness of the layer decreases, thereby reducing its susceptibility to cracking.

● Cold forming
● Hot forming

7. What is the influence of fusion welding on the base material.

Fusion welding is a process in which parts are joined when melting and subsequently solidifying the filler and base material. It is a metallurgical process taking place in a relatively small volume of metal (as compared to metallurgical processes in steel smelting or casting production). The effect of welding on the base material can be explained by the superposition of the temperature and deformation cycle of welding. In terms of reliability, the operation of the welded structure is important to what extent the thermal deformation process changes the structure and thus the mechanical and other properties of the welded joint. The requirements for mechanical properties are given by the stresses to which the welded structure is subjected. In order to fully exploit the strength and toughness of the base material during operation of the structure, its strength and toughness must correspond to the mechanical properties of both the weld metal and the heat affected area of the weld joint.

8. Define the weldability of the material and the assessment of the weldability of the steel

Weldability is a complex characteristic that expresses the suitability of a metal to produce welds of the desired properties with structural reliability of the weld joint and certain technological possibilities of welding. Weldability refers to metallurgical, structural and technological weldability.

● **Weldability metallurgical**
(a) Chemical composition of base and filler material
(b) Quality and purity of metallurgical raw materials
(c) Method of casting and forming
(d) Heat treatment

● **Structural weldability**
(a) Material thickness that determines the state of stress
(b) Shape of weld and weld surfaces
(c) Stiffness of the weld joint
(d) Distribution and number of welds

- **Technological weldability**
  (a) A welding process that affects the amount of heat introduced into the weld
  (b) Additive material, in particular its chemical composition
  (c) Specific heat input of welding
  (d) Welding procedure
  (e) Pre-welding

9. Describe the welding metallurgical processes.

The basic metallurgical processes include:

1. Oxidation of weld metal

2. Reduction processes of manganese and silicon with simultaneous oxidation of weld metal

3. Deoxidation of FeO dissolved in the weld pool

4. Removing harmful nitrogen, hydrogen, sulfur and phosphorus from the weld pool