VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF MECHANICAL ENGINEERING

Questions for the state final exam

Master study programme N0715A270009 – Industrial Engineering,

academic year 2022/2023

UNCONVENTIONAL TECHNOLOGICAL PROCESSES

1. Technical iron alloys; definition and division of steels according to the chemical composition, and according to the main quality groups.
2. Designation of steels according to their use, mechanical and physical properties or according to their chemical composition. Types of metal product inspection documents.
3. External and internal defects of steel products – non-destructive testing of materials (visual inspection, penetration test, ultrasonic and radiation test).
4. Mechanical properties of metallic materials – tensile test; impact test; hardness test; bending test.
5. Influence of forming on material properties and structure – definition and meaning of forming; basic mechanisms of plastic deformation; critical shear stress; material strengthening; strengthening curves; basic factors influencing plastic deformation (influence of structure, temperature, friction, stress, and strain rate).
6. Cold volume forming - advantages of the technology; basic methods of cold volume forming; calculation of relative, and logarithmic deformations; strengthening curves; design of a technological process for the production of extrusion; material choice; determination of shape, and dimensions of a semi-finished product; preparation before forming; the number of forming operations; technological principles for the design of extrusions, and tools; forming force, and work; finishing of stampings.
7. Sheet metal drawing – drawing division; drawing without wall thinning; technological parameters of drawing – shape, and size of blank; the number of drawing operations, and their gradation; use of holder; the size of a drawing gap; the shape of drawing die and drawing punch; drawing force; drawing speed; the

roughness of sheet metal, and tool's functional parts; lubrication. Drawing of non-rotating cups (drawing of a square, stepped, conical, spherical cups, drawing of cups of irregular shapes, use of drawbeads); progressive strip drawing (without cutting, with cutting, with tearing of the strip); drawing with thinning of the wall.

8. Unconventional forming methods - drawing with a flexible drawing die; drawing with flexible drawing punch; thermal drawing; drawing of superplastic materials; drawing with expansion drawing punch; metal stamping; electrohydraulic, electromagnetic, hydromechanical, frequency and ultrasonic forming; explosion forming; gas expansion forming.

9. Industrial robots; area of application; characteristic properties of industrial robots; criteria for robot selection; design of robotic workplaces.

10. Technological design of forgings, and flat stampings – advantages, and goals of hot die forging; the relationship between production size, and cost; basic principles of forgings design; prediction of tool life; advantages, and goals of flat forming; minimization of consumption of flat semi-finished products; technological design of bent parts; eliminating measures suspension; technological construction of sheet metal extracts.

11. Welded steel, and aluminium structures - types of steel, and aluminium structures; materials for steel, and aluminium structures; division according to the stress loading method; used types of welded joints; stress loading, and method of structure calculation; differences between the design of steel, and aluminium structures.

12. Pressure vessels, and constructions of concrete reinforcements – types, and construction solutions of pressure vessels, and concrete reinforcements; methods of stress loading of pressure vessels; used materials for pressure vessels, and concrete reinforcements; design of welded joints, and welding methods; defects of welded joints of pressure vessels, and concrete reinforcements.

13. Other types of structures – plastic structures; glued structures; ship, aircraft, and car structures - types of used welded and glued joints; joint degradation; methods of joining homogeneous, and heterogeneous joints of materials; joint life.

14. Electroerosive machining technologies; electrochemical, and chemical principles of machining.

15. Concentrated energy beam machining (laser, plasma, electron, and ion beam machining).

16. Unconventional machining methods – mechanical principles of machining (ultrasonic machining, abrasive water jet machining).

17. High energy beam welding technology – plasma, laser, electron beam – the principle of the method, possibilities of the technology, welded materials, advantages, and disadvantages.

18. Methods of pressure welding – resistance welding; cold pressure welding; friction welding – the principle of the method, possibilities of the technology, welded materials, advantages, and disadvantages.

19. Special welding methods – explosion welding; electro slag welding; diffusion welding; stud welding; ultrasonic welding; WAAM (Wire and Arc Additive Manufacture) – 3D printing, plastic welding, advantages, disadvantages, and possibilities of the technology.

20. Other methods - thermal spraying, welding of worn surfaces, thermal separation of materials, MAG soldering, advantages, disadvantages, and possibilities of the technology.