

Final Exam Topics

for Students of Civil Engineering BSc

Effective from 6 September 2021

A1 Theoretical Mechanics

1. Introduce the force systems (concurrent, parallel, general), define their resultants and their equilibrant forces. Show an example for a structural static model and its application.
2. Internal forces of simple structures. Introduce the normal, the shear and the moment functions of simply supported, overhanging straight and angled beams. Present the interdependence of them.
3. Static equilibrium of determinate compound structures. Introduce the internal force diagrams of Gerber beams and three hinged frames. Present an example of reality.
4. Material models in strength design, Hooke's-law, generalized Hooke's-law. Present the application of Hooke's-law in case of pure tension. Present some material model of structural materials.
5. Geometric properties of an area: area, moment of the area, centroid, moments of inertia for an area. Major and minor axes and importance.
6. Determination of simple stresses: pure tension-compression, flexural buckling of columns, pure bending, coupled bending, pure shear, torsion.
7. Determination of stresses at coupled internal forces: eccentric normal force (tension/compression and bending), determination of the neutral axis, bending and shear, shear and torsion.
8. What do we mean by one DoF, free, undamped, harmonic and linear vibrations? How do we model such a system? What do we mean by the following terms: period, amplitude, natural angular frequency? What is the mathematical form of the displacement in function of time? Give simple examples.
9. What do we mean by one DoF, free, damped vibrations? How do we model such a system? What do we mean by the following terms: dissipation force, relative damping coefficient, natural angular frequency of the damped system, amplitude of the damped system? Give simple examples.
10. Explain the slope and displacement calculation of statically determinate structures by the virtual work theorem.
11. Present the force method technic at statically indeterminate structures (cantilever with an attached rod as an example). Present the force method calculations at continuous, multi supported beam structures with fixed or sinking supports.
12. Present the displacement method technic at statically indeterminate structures (bar members connected at the same joint). Present the moment distribution calculation method at continuous, multi supported beam structures with fixed or sinking supports.
13. Present the moment distribution solution method at supported or non-supported frames.

14. Present the influence lines of statically determinate structures.
15. Present the possible movements of a 2D truss. Explain the contents of a compatibility equation in soft and rigid support cases. Determine the state equation of a truss structure. Describe the elementary and the structural stiffness matrixes of a truss structure, explain the compilation methods.
16. Describe a finite element model of beam structures. Describe the stiffness matrix of an element and of the complete structure, explain the mechanical contents. Present the changes of the elementary stiffness matrixes concerning to the different connection modes eg. rigid connection, pin, flexible connection.
17. Describe and compare the finite element models of frame structures. Explain the function of the local and global coordinate systems, show the possible coordinate transformations. Present the equivalent nodal load vector in case of the different calculation models!
18. Present the geometrical finitization of line, surface and volume elements! Present the applied coordinate systems, describe the shape functions, the importance of their continuity.

A2 Design of Engineering Structures

19. Design of tensioned and compressed steel bars. Structural solutions and design of steel trusses according to EC3.
20. Strength, stability and serviceability design of steel beams under shear and bending according to EC3
21. Design of simple steel connections according to EC3: sheared, tensioned and pre-stressed bolts, welded connections.
22. Design of industrial steel buildings – static behaviour, ultimate and serviceability limit states, design of main structural elements according to EC3.
23. Ultimate and serviceability limit state design methods of mild steel reinforced concrete beams for bending, with or without the simultaneous presence of shear or torsional forces,
24. Present approximate manual calculation methods for internal forces in reinforced concrete frame structures. Describe the verification process of slender columns in frames.
25. Elastic and plastic design reinforced concrete slabs.
26. Structural design of reinforced concrete industrial halls. Static and dynamic effects of bridge cranes.
27. Determination of soil identification, shear strength and Earth pressures.
28. Description of soil investigation methods.
29. Shallow foundation, construction technology, bearing capacity and settlement calculations according to Eurocode 7
30. Earth retaining structures and design methods according to Eurocode 7
31. Design and co-ordination of the horizontal and vertical alignment of roads.
32. Design of new pavement structures and strengthening of existing pavement structures of roads.

33. Set-up of railway tracks. Types of railway track systems and their main properties. Cross section of one and two -track railways in straight and curves.
34. The main types of the elements of the superstructure. Types of protection layers, main properties.
35. The water supply system, the elements of public water supplies.
36. Classification of public sewer systems, based on the operation of the sewer and based on the type of collection and conduct.
37. Pumps at water supply system. Sewage pumping stations
38. Various pipe materials for water supply system and for sewer, and their pros and cons.

A3 Construction Management, Construction Technology

39. Regarding labour norms, describe the following notions:
- The type of norms and their evolution.
 - Ways of preparing norms.
 - Preparation and content of technologically grounded labour norms.
40. Regarding material norms, describe the following notions:
- The content elements of the material norms and the classification of auxiliary structures, the way of setting their norms
 - Types of stocks, stock-keeping mechanisms.
41. Describe the construction cost calculation system as follows:
- The concept and function of the budget in an enterprise
 - The course of preparing the budget
 - Aids to be applied
42. Describe the CPM network diagram organization method through the following notions:
- Theory, elements, advantages
 - Determining the duration of activities
 - Logical analysis and construction of the network
43. Regarding the investment process, describe:
- The role of technical inspection and designer supervision.
 - The technical delivery and acceptance procedure
 - Peculiarities of construction activity
- Responsibilities of the workplace manager (construction manager)
- Its function, management tasks, rights and obligations
 - Workplace technical administration (construction and survey log)
 - Technical delivery and acceptance procedure

Part of the construction technology chapter of the dissertation - elaboration of the state exam topics:

44. Scheduling of earthworks, in technological order (for your own building):
- a.) marking (describing the course of marking from a technological point of view)
 - b.) bracing (tool + order) / retaining walls

c.) earth extraction (equipment, mechanization + technological sequence, including transport)

d.) compaction / spreading (tool, mechanization + technological sequence)

- depending on soil classes

- in the case of being aware of groundwater conditions

45. Technological order of preparing the foundation (for your own building):

a) Preparation of the core body of foundation (guiding through the process of concreting from a technological point of view; production, transport, reception at the site + installation + compaction)

- System of tools, conditions of use.

- Rules of installation of concrete.

- Aftercare – conditions for formworking.

46. Construction of vertical load-bearing structures (for your own building): Analysis of the construction of the load-bearing structure used in the case of your own building according to DTI (detailed technological instructions).

47. Preparation of insulation against soil moisture or groundwater (for your own building):

a. Analysis of the preparation of insulation applied in the case of your own building according to DTI.

48. Comparison of dry-wall or masonry partition walls (for your own building):

a. technological analysis

- detailed technological instructions according to DTI through 8 main considerations: similarities/differences advantages/ disadvantages