

THE SET OF QUESTIONS ON THE M.SC. EXAM	
field of study II level: CHEMICAL TECHNOLOGY	
speciality: ENERGY TRANSITION	
Environmental protection in energy Sector	
1.	The principle of operation, removal efficiency, advantages and disadvantages of PM control devices in power industry (electrostatic precipitators, fabric filters, wet scrubbers)
2.	The principle of operation, removal efficiency, advantages and disadvantages of SO ₂ emission control devices in power industry (limestone wet scrubber and atomizer dry scrubber).
3.	The principle of operation, removal efficiency, advantages and disadvantages of NO _x control devices in power industry – primary methods (examples) and secondary methods (SNCR and SCR)
4.	Waste water treatment in power industry – typical pollutants and their treatment
5.	Waste management in power stations – fly ash utilization and microspheres
6.	Describe and give some examples of natural and anthropogenic current negative changes in environment
7.	Define the specific parts of ecosystem
8.	Explain the processes of dry and wet deposition on the example of the spread of any selected harmful substance
9.	Discuss the basic steps of the waste water treatment process
10.	Major threats to hydrosphere and fresh water reservoirs. Ways of preventing them.
11.	The principle of operation, removal efficiency, advantages and disadvantages of PM control devices in power industry (electrostatic precipitators, fabric filters, wet scrubbers)
12.	The principle of operation, removal efficiency, advantages and disadvantages of SO ₂ emission control devices in power industry (limestone wet scrubber and atomizer dry scrubber).
Computer modelling of technological processes	
13.	What is a flowsheet?
14.	Outline general type of models.
15.	Describe difference of endogenic and exogenic data for the model.
16.	What is a meaning of term “unit process”?

17. Specify general difference between optimization and simulation model.
18. What is a matter of approximation?
Business planning in energy sector
19. How do you understand the role of the business and corporate social responsibility?
20. What is the business plan and what it is used for?
21. Give a definition of a business model?
22. Give a definition of a competitive advantage.
23. Give a definition of a value chain and the product/service.
24. What is market segmentation and targeting?
25. What is a profit and a costs-revenues model?
26. What are the fix and variable costs of power technologies?
27. Give a definition of discounting. What it is used for?
28. Give a definition of Net Present Value.
29. Give a definition of Life Cycle Costs.
30. Discuss the marginal-cost curve and competitive firm supply decision for profit maximisation.
Chemical reactors
31. List the classification of chemical reactors into account different classification criteria.
32. Describe three basic types of ideal chemical reactors.
33. Introduce the overall mass balance of the substrate for Continuous Stirred Tank Reactor (CSTR).
34. Introduce the overall mass balance of the substrate for irreversible second order reaction for CSTR.
35. What is the series of CSTRs (cascade reactors). What are advantages of such systems?
36. What is Batch Reactors, describe their advantages and disadvantages.
37. Describe the advantages and disadvantages of using Continuous Stirred Tank Reactors (CSTRs).
38. What is Plug Flow Reactors (PFR), describe their advantages and disadvantages.
39. What is the relationship between the rate constant and the temperature ?

40. Present the definition of the conversion for reversible and irreversible reactions.
41. What is the isothermal flow reactor model in steady conditions.
42. List the methods for determination of kinetic equations. Describe one of them.
Catalysis in fuel industry and air pollution control
43. The basic differences between physical sorption and chemisorption
44. The ways of expressing catalytic activity and selectivity
45. The structure of catalysts: the role of active component, support and promoters. Types of active materials and the reactions they promote. Typical supports.
46. Deactivation of catalysts – main causes. Preventive methods 47. The methods of catalysts preparation.
47. Characterization of catalysts – methods to determine: texture, structure, dispersion of active component, number and type of acidic and redox sites.
48. Zeolites – structure and role in catalysis
49. Catalysts for DeNO _x processes in power industry.
50. Catalysts for fuels production – Fischer Tropsch synthesis and MTG method.
51. Catalysts for fuels upgrading – HDS, catalytic reforming, hydrocracking
Chemistry of coal
52. Describe in general types of solid fuels, especially coal in accordance to coalification degree.
53. Specify the oxygen groups on the surface of hard coal.
54. Specify types of gases produced from carbonaceous materials.
55. Outline the degasification process?
56. What is volatile matter of coal?
57. Describe solvent extraction of coal?
Biotechnology
58. What is the range of white, blue, red and green biotechnology?
59. Explain the matter of fermentation phenomena.
60. What denotes the term “anaerobic organism”

61. What means the screening of microorganism?
62. Describe in general the process of biological water treatment.
63. What is the role of enzymes?
Gasification
64. Discuss the electric energy generation efficiency for thermal power plant and for natural gas combined cycle.
65. What is the coal combined cycle and how does it impact the efficiency of a power plant?
66. What is the advantage of IGCC in carbon capture over conventional thermal power plant equipped with CCS?
67. How is coal appraised and tested? What type of coal is the most suitable for slurry fed gasifier?
68. What makes hydrogen an attractive energy source and how might it be implemented? Draw a gasification process block diagram for hydrogen production.
69. Explain what gasification is and its purpose. Name main applications. What is meant by a hydrogen economy? In your opinion, how feasible is this idea?
70. Explain the term "slagging gasifier." Describe the conversion and a role of coal mineral matter during high temperature gasification in entrained flow reactors.
71. Describe the typical reactor constructions for biomass gasification. List the advantages and disadvantages of biomass as the feedstock for gasification process.
72. Describe typical technologies for acid gas removal in gasification systems. Explain the advantages of hot gas cleaning in power production systems.
73. What types of gasifiers can you list depending on the way gas and coal contact?
74. List the main gasification reactions and explain their role in a process.
75. What chemical species form the syngas and what is the effect of gasification process? How the gas is to be process to make it ready for further synthesis?
76. Water gas shift – explain a purpose and process arrangement.
77. Draw an IGCC process block diagram with and without CO ₂ removal.
78. Describe the role and importance of ASU in production systems integrated with coal gasification.
Carbon dioxide mitigation technologies
79. Greenhouse gases. The role of CO ₂ in climate changes.
80. CO ₂ – physical and chemical properties. Health and safety aspects.
81. What are CCS methods?
82. Describe carbon dioxide capture processes. When physical and chemical absorption processes are applied?

83.	Describe 3 methods of CO ₂ sequestration.
84.	What are carbon dioxide storage opportunities? List them and describe shortly.
85.	Which are biological, chemical and technological options for utilization of CO ₂ ?
86.	Describe the constraints on chemical use of CO ₂ .
87.	Describe the possibilities of CO ₂ utilization in the following processes: dry reforming of methane, tri-reforming of methane and methanation.
88.	How dry reforming of methane or methanation of CO ₂ may be applied for energy storage?