

# Table of contents

## Part I. Script

<b>Chapter 1</b>	<b>Introduction to Energy Engineering and to Energy Economy</b>	<b>1.1</b>
1.1	What is Energy Engineering	1.1
1.2	Some important events in the history of Energy Engineering	1.2
1.3	Concepts and Energy Flow Diagrams in Energy Engineering	1.3
1.4	Primary energy	1.5
1.5	Final energy	1.6
1.6	Historical developments	1.8
1.7	Energy carriers	1.9
	1.7.1 Oil	1.9
	1.7.2 Natural gas	1.11
	1.7.3 Coal	1.13
1.8	Electrical energy	1.14
1.9	Emissions	1.17
1.10	Prices of fuels	1.18
1.11	Bibliography	1.19
<b>Chapter 2</b>	<b>Thermodynamic Analysis. Concept of Exergy</b>	<b>2.1</b>
2.1	Basic concepts and definitions	2.1
	2.1.1 System	2.1
	2.1.2 State. Property	2.2
	2.1.3 Process. Cycle	2.2
	2.1.4 Equilibrium. Balance	2.2
2.2	The first law of thermodynamics. Energy	2.2
2.3	The second law of thermodynamics and Entropy	2.7
2.4	Ideal thermodynamic processes and ideal cycles	2.13
	2.4.1 Ideal thermodynamic processes	2.13
	2.4.2 Ideal thermodynamic cycles	2.13
2.5	Properties of working fluids	2.15
2.6	Exergy	2.22
	2.6.1 Definition of exergy and the reference environment	2.22
	2.6.2 Components of exergy	2.22
	2.6.3 Physical exergy	2.24
	2.6.4 Chemical exergy	2.25
	2.6.5 Exergy balance	2.31
	2.6.6 Exergy analysis	2.33
2.7	Analysis of simple processes	2.41
	2.7.1 Compressor, pump, or fan	2.41
	2.7.2 Turbine (expander)	2.43
	2.7.3 Heat exchanger	2.44
	2.7.4 Combustion chamber	2.49
2.8	Analysis of simple energy conversion systems	2.57
	2.8.1 Energy conversion systems working according to direct thermodynamic cycles	2.57
	2.8.2 Energy conversion systems working according to inverse thermodynamic cycles	2.58
	2.8.3 Energy conversion systems combining a direct and an inverse thermodynamic cycle	2.59
2.9	Exergy-energy concept	2.60
2.10	Bibliography	2.61

<b>Chapter 3</b>	<b>Power Generation Systems</b>	<b>3.1</b>
	3.1 Steam power systems	3.1
	3.2 Gas-turbine power systems	3.14
	3.3 Combined-cycle power systems	3.23
	3.4 Bibliography	3.28
<b>Chapter 4</b>	<b>Cogeneration systems</b>	<b>4.1</b>
	4.1 Advantages and disadvantages	4.1
	4.2 Thermodynamic analysis	4.2
	4.3 Cogeneration concepts	4.3
	3.4 Bibliography	4.6
<b>Chapter 5</b>	<b>Components of the power systems: Design and Operation</b>	<b>5.1</b>
	5.1 Combustion chambers	5.1
	5.1.1. Combustion chambers in gas-turbine systems	5.1
	5.1.2. Steam generators	5.2
	5.1.3. Emissions	5.4
	5.2 Heat exchangers	5.7
	5.3 Turbines	5.16
	5.3.1 Impulse steam turbines	5.16
	5.3.2 Reaction steam turbines	5.17
	5.3.3 Steam turbine types	5.17
	5.3.4 Gas expanders	5.18
	5.4 Compressors	5.19
	5.4.1 Piston (reciprocating) compressors	5.19
	5.4.2 Rotary compressors	5.19
	5.4.3 Screw compressors	5.20
	5.4.4 Scroll compressors	5.20
	5.4.5 Turbo compressors	5.20
	5.5 Pumps	5.21
	5.6 Fans	5.23
	5.7 Systems for removing heat	5.24
	5.8 Bibliography	5.28

## Part II. Tutorials

<b>Tutorial for Chapter 2</b>	<b>Simple thermodynamic processes</b>	<b>T.1</b>
	Thermodynamic diagrams	T.1
	Compressor (energy and exergy analysis)	T.2
	Turbine (energy and exergy analysis)	T.9
	Heat exchanger (energy and exergy analysis)	T.12
	Combustion chamber (energy and exergy analysis)	T.16
<b>Tutorial for Chapter 3</b>	<b>Power Generation Systems</b>	<b>T.27</b>
	Steam power system	T.27
	Open-cycle gas-turbine power system	T.31
	Closed-cycle gas-turbine system	T.33