Sektion Berufsbildung

Technische und gewerbliche Schulen
Technical and Vocational Schools and Colleges

Lehrplan der Höheren Lehranstalt für Elektrotechnik
Curriculum of the Secondary College of Electrical Engineering

(BGBl. II Nr. 302/1997)

English edition - May 1998

Höhere technische Lehranstalten mit Elektrotechnik - Abteilungen/ Secondary Technical Colleges with Departments of Electrical Engineering

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CURRICULUM OF THE SECONDARY COLLEGE OF ELECTRICAL ENGINEERING

Program Codes:

8360 ... 1st and 2nd Year

8361 ... 3rd to 5th Year, Power Engineering and Industrial Electronics

8362 ... 3rd to 5th Year, Control Engineering

I. SUBJECT TIME TABLE [1)]

(Total number of lessons and number of weekly lessons of the different subjects)

A. COMPULSORY SUBJECTS	Lessons per Week Year 1	2	3	4	5	Sum	Teaching Assignment Group
1. Religious Instructions	2	2	2	2	2	10	III
2. German	3	2	2	2	2	11	I
3. English	2	2	2	2	3	11	I
4. History and Political Education	–	–	–	2	2	4	III
5. Physical Education	2	2	2	1	1	8	IVa
6. Geography and Economics	2	2	–	–	–	4	III
7. Economy and Law	–	–	–	3	2	5	III
8. Applied Mathematics	4	4	3	3	2	16	I
9. Applied Physics	2	2	2	–	–	6	II
10. Applied Chemistry and Ecology	3	2	–	–	–	5	II
11. Descriptive Geometry [2)]	2	–	–	–	–	2	I
12. Applied Computer Science	2	2	–	–	–	4	I
13. Fundamentals of Mechanical Engineering	2	4	–	–	–	6	I
14. General Electrical Engineering [3)]	3	5	2	–	–	10	I
15. Electronics	–	–	2	2	–	4	I
16. Design Practice [4)]	2	2	–	–	–	4	I
17. Laboratory	–	–	3	–	–	3	I
18. Workshop-Laboratory	–	–	4	–	–	4	III
19. Workshop	8	8	4	–	–	20	Va
Compulsory Subjects of School-Autonomous "Special Training Focuses" in compliance with Section B.	–	–	11	23	24	58	
Total number of lessons per week…	39	39	39	39	39	195	

B. COMPULSORY SUBJECTS OF SCHOOL-AUTONOMOUS SPECIAL FOCUSES	Lessons per Week Year 3	4	5	Sum	Teaching Assignment Group
B.1 Power Engineering and Industrial Electronics					
1.1 Measurement Technology and Control Engineering	3	4	2	9	I
1.2 Electric Drive Systems and Power Electronics	3	3	3	9	I
1.3 Electric Systems	3	3	3	9	I
1.4 Electronics and Micro-Electronics	–	2	2	4	I
1.5 Design Practice	2	4	4	10	I
1.6 Laboratory	–	4	7	11	I
1.7 Workshop-Laboratory	–	3	3	6	III
Total number of weekly lessons B.1	11	23	24	58	

B. COMPULSORY SUBJECTS OF SCHOOL-AUTONOMOUS SPECIAL FOCUSES		Lessons per Week Year 3	4	5	Sum	Teaching Assignment Group
B.2	**Control Engineering**					
2.1	Measurement Technology	2	2	2	6	I
2.2	Open- and Closed-loop Control Engineering	2	3	3	8	I
2.3	Drive System Engineering and Electric Systems	2	3	2	7	I
2.4	Electronics	–	2	2	4	I
2.5	Process Data Technology [4])	3	3	2	8	I
2.6	Design Practice	2	3	3	8	I
2.7	Laboratory	–	4	7	11	I
2.8	Workshop-Laboratory	–	3	3	6	III
	Total number of weekly lessons B.2	11	23	24	58	

Mandatory Work-Placement: Minimum of 8 weeks during vacation before 5th year

C. OPTIONAL SUBJECTS, NON-OBLIGATORY PRACTICE, TUTORIALS		Lessons per Week Year 1	2	3	4	5	Teaching Assignment Group
C.1	**Optional Subjects** [1])						
	Second Modern Language [5])	2	2	2	2	2	I
	Communication and Presentation	2	2	2	2	2	III
C.2	**Non-Obligatory Practice** [1])						
	Physical Education	2	2	2	2	2	IVa
C.3	**Tutorials** [6])						
	German						
	English						
	Applied Mathematics						
	Relevant Theoretical Compulsory Subjects						

[1]) Within the framework of section III deviations from subject-table are permitted by school-autonomous provisions for curricula.
[2]) In combination with relevant practice of 1 weekly lesson in "Applied Electronic Data Processing".
[3]) In combination with practice of 2 weekly lessons in the 1st and 2nd years, respectively.
[4]) In combination with relevant practice of 1 weekly lesson in "Applied Electronic Data Processing" in the 3rd and 4th years, respectively.
[5]) Name of the language has to mentioned in official papers.
[6]) Parallel to the respective compulsory subjects up to 16 lessons per school year; classification like corresponding compulsory subject.

II. GENERAL EDUCATION OBJECTIVES

Within the framework of the Austrian school system Secondary Technical and Vocational Colleges are designed to provide students with both general education and vocational training, which

- will enable them to pursue a highly qualified occupation and carry on a business in trade and industry.
- grants university access.

In order to meet the needs and requirements of everyday and professional life and in order to be prepared for the challenge of an academic career the graduate of a Secondary Technical and Vocational College will be equipped with professional skills (theoretical and practical knowledge of business-relevant and related topics), methodical competence (capability of gathering information, planning solutions to problems and selecting and applying suitable methods.), social consciousness (ability of co-operation, communication and working in teams) and individual creativity (capacity to organise his personal and professional life and his own personality actively, to show self-initiative and interest in further education).

In accordance with this comprehensive conception of competence the graduate of a Secondary Technical and Vocational College will acquire the following qualifications:

- He will get a sound engineering knowledge up to date required for everyday and professional life and an academic career. He will know business-relevant legal regulations, standards and practices and be able to employ and operate commonly used devices.
- He will observe and evaluate routines, facts, processes and strategies and be able to describe them in correct German and in at least one foreign language, written and orally.He will also be able to represent them by symbols used in mathematics and information science. The graduate will further be able to gain information from the media, evaluate it critically and relate it to other ideas.
- He will gain an insight into processes of political and managerial economy and will be informed about business administration and law, which will enable him to pursue a trade, a craft or a career in industry. He will further be able to further develop and utilise his skills in business life.
- He will be provided with fundamentals of engineering and science, basic concepts of mathematics and science in order to be ready to deal with issues relevant to everyday life and ecology. Complementary to business training he will further develop general interdisciplinany skills.
- He will be prepared to participate in public and cultural life; he will declare himself to co- and self- determination in democracy and show responsibility in the presence of ecological and political changes by standing up for international understanding, professional ethos, a critical attitude towards consumption, environmental protection and a conduct of partnership and devote his life to these values. He will recognise the meaning of co-operation within the European Union and with other countries.
- He will support a concept of proficiency consistent with society and environment and preserve this proficiency and health by his own attitude towards the way of life, leisure culture and further education. He will be ready to apply these principles to his staff, and foster them by an open management style.

In the sense of general education schools have to face additional tasks which are summarised in teaching principles. Among them are: Health, media and sexual education, political awareness, an acceptance of the equality between men and women, concern for the environment, traffic concepts, a comprehensive national defence as well as an education concerning economy and consumption.

Subject-Relevant Training Objectives:
The Secondary College of Electrical Engineering provides theoretical and practical concepts in electrical power engineering, industrial electronics and control engineering. The course also stresses skills in manufacturing technology and industrial engineering relevant in business practice. General business training is intensified by two alternative special training focuses.

- Special focus on “Power Engineering and Industrial Electronics“: This course emphasises economic and ecological generation, distribution and application of electrical energy as well as industrial utilisation of electronic components and devices.
- Special focus on “Control Engineering“: The course specialises on the acquisition, preparation and processing of measurement data for the automation of industrial processes and the design and dimensioning of control systems as well as the application of relevant software.

Graduates are trained to work in projecting, manufacture, sale, commissioning and maintenance of electric plants and electronic control systems as well as in planning, sales and service of hard and software.

III. SCHOOL-AUTONOMOUS PROVISIONS FOR CURRICULA

IIIa. General Provisions

School-autonomous provisions for curricula (School Organisation Law §6/1) grant schools independence in the organisation of subject-timetables and curricula-determined teaching-contents (syllabi of the different subjects) and in the choice of training and work forms as well as in the organisation of the training.
In order to make efficient use of these opportunities it is essential to be aware of the special needs and problems of the respective school or class at a certain location as well as the resulting ambitions and aims thereof. This independence requires the development of concepts which consider the needs of students, parents and teachers alike as well as the specific characteristics of the school.

School-autonomous provisions for curricula must not only observe the extent of teachers´ weekly assignments provided but also institutional facilities such as rooms and equipment.

School-autonomous provisions for curricula have to consider training objectives concerning general education as well as occupation-oriented theoretical knowledge and practical skills. Within the framework of the Austrian school system they also have to provide students with the opportunity to transfer courses.

IIIb. School-Autonomous Deviations from Subject-Tables

School-autonomous provisions for curricula allow schools to work out their own tables of compulsory subjects, which may deviate from the standard ones, provided the following provisions are considered:

1. It is permitted to change the distribution of the total number of compulsory weekly lessons and their respective contents over the years.
2. During the course the number of weekly compulsory subjects can be reduced by up to ten lessons a week, if - in return - additional compulsory subjects are introduced or the number of lessons of curricular compulsory subjects is increased to the same extent. This reduction is limited by the fact that compulsory subjects may only be reduced by one lesson a week. The reductions must not cause a complete loss of a compulsory subject in one year.
3. In each year a compulsory subject can be combined with another methodically and content related compulsory subject to one comprehensive compulsory subject. The new name must refer to the names of the two subjects which the new subject derives from.
4. Instead of the compulsory subject English another modern language can be taught.

If paragraphs 1. or 2. are applied, special consideration has to be given to the fact that the total number of weekly lessons of the course must be preserved and that there must not be more than 40 lessons per week in any year. School-autonomous provisions for curricula may establish extra-curricular optional subjects , non-obligatory practice lessons and tutorials as well as change the number of lessons for corresponding programmes provided by the curriculum.

IIIc. School-Autonomous Provisions for Training Focuses

If curricula include school-autonomous training focuses, these school-specific focuses have to be determined by school-autonomous provisions for curricula. Some focuses can be established as alternative compulsory subjects.

IIId. Provisions concerning Contents of Subjects and Classification of Subjects according to Teaching Assignment Groups

(1) If extra-curricular subjects are created or if subjects for which the curriculum provides no contents are established within the framework of school-autonomous provisions for curricula, school-autonomous provisions for curricula have to contain relevant directions. If school-autonomous provisions for subjects provide an increase in the number of lessons, additional training and teaching aims, descriptions of contents and didactic principles may be defined.
(2) If additional subjects are created or existing subjects are changed subject-relevant training objectives of the curriculum and the following directions have to be observed.

Directions for **Training and Teaching Aims**:
The student will acquire general and subject-relevant competences which - under special consideration of regional requirements - emphasise and complete attitudes, knowledge and skills provided in other compulsory subjects.

Directions for **Contents**:
If contents include topics which cannot be covered by increasing the number of curricular lessons the following additional subjects have to be provided:

“Foreign Language“:
Another modern language whose organisation of contents and didactic principles is equivalent to those of the compulsory subject English. (Teaching assignment group I)

“Personality Training“:
Promotion of self-development by teaching offers concerned with general education, humanities and business practice. (For classification into teaching assignment groups see §7 of Teaching Assignment Law for federal teachers)

“Economy and Technology“:
Teaching programmes which emphasise economic training relevant to the specific technical field.(Teaching assignment group I for training areas management engineering, electronic data processing and organisation; otherwise teaching assignment group II)

“Law and Political Education“:

Teaching courses which stress political education and subjects concerning law with special regard to independent practice of trade. (Teaching assignment group III)

“Environment“:
Introduction to domains of general science in addition to technical-scientific education. (Teaching assignment group III)

“Special Theoretical Subject Training“:
Supplementary courses with non-encyclopaedic syllabi. (Teaching assignment group I)

“Projects“:
Teaching offers which aim at interdisciplinary strategies within the domain under special consideration of theoretical and practical laboratory assessments. (Teaching assignment group I)

“General Theoretical Subject Training“:
Introduction to engineering disciplines which are not focused on in the rest of the course. (Teaching assignment group II)

Directions for **Didactic Principles**:
Pedagogic concepts should foster the student´s ability to co-operate, his intellectual flexibility and his concern for his social, economic and ecological surroundings. Project teaching - even if involving students from different grades or block tuition- is recommended wherever possible.

DIDACTIC PRINCIPLES

IIIe. Preparations of Contents

In order to reach the general training objectives educational background of students have to be considered and the contents of the subjects have to be selected according to practical requirements of the subject field.

Sound knowledge of essential contents should be preferred to an overall outline. In order to foster motivation new topics have to be introduced with an orientation to practical problems. Cross- references within a subject and between subjects are essential for understanding the subject matter and for the development of interdisciplinary skills.

It is decisive for training success that subject matter is arranged clearly and according to the age of the students. Teaching - and understanding aids, especially those prepared by the teachers themselves, contribute to this success.

In order to provide the students with skills in due time and to avoid parallelisms teachers will have to work in teams. It is recommended to build up a network of related subjects in the form of co-ordinated content-distribution-plans.

As general education and training aims require training to be up to the state of the art, teachers are expected to improve their specific knowledge and skills continuously. The curriculum presents a directive framework for this purpose.

IIIf. Organisation of Lectures

Working on projects in groups simulates practice in business situations and emphasises the students´ communicative competence. The student will profit by the fact that his fellow students encourage and criticise his way of solving problems and his self analysis, which is essential for training progress and future professional work forms.

Excursions, field practice, lectures of industrial experts and work placement grant an insight into relations between technology and business organisation as well as into social aspects of professional life.

All lectures listed in the subject-table can partly or completely be given in block tuition (1 lesson per week corresponds to 40 lectures a year).

Different themes of a subject can be taught by different teachers according to the teachers´ skills and special knowledge; teachers should aim at good co-operation with respect to their common assessment of the students´ proficiences.

For pedagogic and organisational reasons different subjects can be combined to form concentrated training units. (School Time Law 1985, §4/2, Federal Law Gazette 77, as amended)

IV. SYLLABUS FOR RELIGIOUS KNOWLEDGE LESSONS

a.) Roman Catholic Instructions
See promulgation of Federal Law Gazette 30/1984

b.) Protestant Instruction
See promulgation of Federal Law Gazette 515/1991

c.) Old Catholic Instructions
are generally given in groups according to the Law of Religious Instructions §7 as amended. Consequently the syllabus for the upper level of Secondary Academic Schools is to be applied.

d.) Islamic Instructions
See promulgation of Federal Law Gazette 421/1983.

e.) Israelite Instructions
Promulgation of Federal Law Gazette 88/1985 as amended shall analogously be applied.

f.) New Apostolic Church Instructions
See promulgation of Federal Law Gazette 269/1986.

g.) Instructions of The Church of Jesus Christ of the Latter Day Saints
See promulgation of Federal Law Gazette 239/1988.

h.) Syrian-Orthodox Instructions
See promulgation of Federal Law Gazette 467/1988.

i.) Greek-Orthodox Instructions
See promulgation of Federal Law Gazette 441/1991.

j.) Buddhist Instructions
See promulgation of Federal Law Gazette 255/1992.

V. TRAINING AND TEACHING AIMS OF SUBJECTS; DISTRIBUTION OF CONTENTS OVER THE YEARS

A. COMPULSORY SUBJECTS

2. GERMAN

Training and Teaching Aims:
The student will
- have command of the standard German language in speech and writing.
- be able to make efficient use of means providing information on pronunciation, orthography grammar and style and gather relevant information on cultural and professional affairs.
- be able to develop and master personal and professional communicative situations in speech and writing state and present facts adequately to addressee and situation and evaluate business-oriented texts independently and critically.
- comprehend the quality of literary works, be able to evaluate it and gain an insight into the contents of other art forms.
- understand the function of the media as institutions, economic factors as well as educational, entertainment and information facilities. Within the range of his activities he will further be capable of dealing with media consciously, critically and participatingly.

Contents:
1st Year:
Correctness of Language:
Practice-oriented application of orthography and punctuation. Spelling and meaning of frequently used foreign words, technical terms. Language structures (identification, application).

Oral Communication:
Presentation of facts (that have been experienced, heard, seen or read) in standard language. Phone calls, reports, discussions.

Written Communication:
Practice-oriented textforms (report, summary curriculum vitae, letter of application). Creative text forms.

Literature, Art and Society:
Topics from the student´s experiences treated in literature and other art forms (themes, motifs, formal aspects, descriptions, explanations, evaluation of texts). Literary genres.

Media:
Mass media (kinds and functions); advertising and consumption; sources of information (reference books, institutions, use of libraries)

2nd Year:
Oral and Written Communication:
Presentation of facts and the course of events, characterisations, analysing, commentaries. Presentation, making appeals, petitions, excerpts, minutes. Basic concepts of communication. Free creative writing.

Language Standards:
Training and improvement, orthography, punctuation, vocabulary and language structures.

Literature, Art and Society:
Society relevant topics in literature and other art forms (themes, motifs, formal aspects, description, explanation, evaluation of texts)

Media:
Styles in journalism and advertising.

3rd Year:
Written and Oral Communication:
Argumentation, commentaries, subject-relevant reports, technical texts, statements, interviews, conversation and discussion techniques. Communication techniques. Creative writing.

Language Standards:
Training and improvement. Orthography, punctuation, vocabulary and language structures.

Literature, Art and Society:
History of civilisation up to the beginning of the 19th century (époques in the light of intellectual history). Text commentaries and evaluations.

Media:
Creative criteria and means of manipulation of mass media.

4th Year:
Oral and Written Communication:
Speech and lecture. Analysing and comments. Written reports. Creative writing.

Language Standards:
Training and improvement. Orthography, punctuation, vocabulary and language structure.

Literature, Art and Society:
History of civilisation of the 19th century (époques in the light of intellectual history); evaluation of texts. Relations to other art forms.

5th Year:
Oral and Written Communication:
Job interview, letters of application, negotiations, debates, analysis and evaluation. Written report. Presentation techniques. Free writing.

Language Standards:
Training and improvement. Orthography, punctuation, vocabulary and language structures.

Literature, Art and Society:
History of civilisation of the 20th century (époques in the light of intellectual history); evaluation of texts. Commentaries on cultural works and contemporary developments.

Media:
Evaluation of media contents, analysis of effects.

In each year two to four written tests, which may require one or more lessons.

3. ENGLISH

Training and Teaching Aims:
The student will
- be able to master general and business-relevant communicative situations in the foreign language by showing skills in listening and reading comprehension and speech and writing; emphasis is laid on communicative skills and understanding.
- will be able to transfer information precisely from his mother tongue into the target language and vice versa and comment on it.
- will be able to deal with practical business events in speech and writing under special consideration of commonly used communication forms; he will also be able to join business-relevant group activities with English as a working language.
- will be able to employ technical tools for communication and information suitable for the specific situation and make use of modern presentation and moderation techniques.

Contents:
1st Year:
General Communication Topics:
Integration of previous experiences in communication; topics adequate to the student's knowledge, skills and interests.

Business-Relevant Communication Topics:
Elementary technical facts of the subject discipline; basic scientific and mathematical concepts.

Vocabulary and Language Structures:
Integration of previously acquired skills. Repetition and supplementation of grammatical skills and vocabulary required for idiomatic expression in the fields of relevant communication topics.

2nd Year.
General Communication Topics:
Themes taken from the student´s social surroundings. Current issues.

Practice-Relevant Communication Topics:
Applications of scientific and basic technical subjects.

Vocabulary and Language Structures:
Extension of vocabulary and language structures required for expressing facts of relevant communicative themes.

3rd Year:
General Communication Topics:
Topics with special focus on Austria; current issues.

Practice-Relevant Communication Topics:
Products and processes of the subject area.

Vocabulary and Language Structures:
Training and improvement of vocabulary and language structure required for expressing facts of relevant communicative themes.

4th Year:

General Communication Topics:
Topics related to countries of the English speaking world and the European Community; current issues.

Business-Relevant Communication Topics:
Topics relevant to business administration and management engineering.

Vocabulary and Language Structures:
Complex contents of grammar and vocabulary.

5th Year:
General Communication Topics:
Topics of international relevance; current issues.

Business-Relevant Communication Topics:
Complex themes of business practice; business management and business organisation.

Vocabulary and Language Structures:
Applications of acquired structures and vocabulary; summarising survey.

In each year two to four written tests, which may require one or two lessons.

4. HISTORY AND POLITICAL EDUCATION

Training and Teaching Aims:
The student will
- be provided with historical knowledge relevant to everyday and business life under special consideration of Austrian history and he will be able to make use of this in his political and social activities.
- be able to gather and evaluate information required for an understanding of the contemporary situation of the world and the interactions of politics, economy and culture.
- be able to analyse and assess contemporary political, social, economic and cultural situations and processes relying on historical models.
- know the historical development of the branch of trade he has been trained for and relate it to the general historical development as well as affirm the preservation of cultural heritage.
- be prepared to participate actively in public and cultural life and show political and social responsibility; he will affirm the principles of the Austrian federal constitution and he will also be ready to meet different cultures and settle conflicts peacefully.
- be informed about development tendencies of the contemporary society.
- be conscious of environment and critical of consumption.

Contents:
4th Year:
Classical Antiquity:
Cultural and scientific heritage (democratic tendencies, religious heritage).

Middle Ages:
Culture and society in feudalism; development in Austria (formation of Austrian lands); from the theocentric to an anthropocentric view of the world.

Early Modern Times:
Inventions and discoveries; economy (from feudalism to early capitalism); culture, society and science (Renaissance, humanism, reformation; foundation of modern territorial states); developments in Austria.

Age of Reason and the Civil Revolution:
Basic spiritual concepts, state theories, revolution and Restoration, foundation of the United States; Napoleon and Europe; nationalism and liberalism; (human rights, separation of powers, development of parliamentarism); Industrial Revolution and social issues; society, economy, culture, science and technology. Development in Austria.

Age of Imperialism:
National unification endeavours; Europeanising of the world; Europe before the First World War; First World War; society (haute bourgeoisie, industrial society, women´s liberation); ideologies and political movements (mass parties, right to vote); economy, science (evolution), technology, culture; development in Austria.

5th Year:
Tendencies and Developments in the 20th Century - the Period before 1945:
Russian revolution. Reorganisation of Europe; totalitarian ideologies and systems (politics, persecution, resistance); crises of democracies; League of Nations; non-European developments; Second World War; society, economy, culture (inflation, world depression, governmental control, science, technology); development in Austria (domestic and foreign policy of the First Republic, time of national socialism).

Tendencies and Developments in the 20th Century - the Period after 1945:
United Nations and international organisations; east-west-conflict (formation of blocks, political centres of conflict), unification of Europe (EEC, Council of Europe, European Community, European Economic Area, EU); de-colonisation and movement of the non-aligned countries; north-south-conflict; racism, alternative movements, terrorism, social conflicts; peace initiatives; society, culture, economy (economic growth and ecology, science, technology); developments in Austria (domestic and foreign policy of the Second Republic, neutrality, social partnership between employers and employed)

Contemporary Social and Political Developments:
Changes and conflicts in Eastern and Southern Europe. Nationalism. Migration and multicultural society. Political dimension of European integration.

Basic Concepts of Politics:
Democracy (direct and indirect democracy; parliamentarism). Formation of political will in democracy (elections, parties, representations of interest). Areas of the Austrian political system. International politics. Basic constitutional rights, rights of freedom and human rights.

5. PHYSICAL EDUCATION

See Federal Law Gazette 37/1989.

6. GEOGRAPHY WITH ECONOMICS

Training and Teaching Aims:
The student will
- be provided with regional and global topographic knowledge relevant to business and leisure time.
- be able to gather, evaluate and present information necessary for the investigation and assessment of living spaces.
- display a knowledge in economic geography.
- be able to explain geofactors and comment on their networking in ecological and economic systems.
- be informed about the limitations of the earth´s resources and be able to explain the conflicts caused by their exploitation and distribution.
- be able to analyse individual and social demands for geographic space and recognise social aspects.
- understand the meaning of regional development and area development planning for securing quality of life.
- be ready to participate responsibly in the arrangement and preservation of living space.

Contents:
1st Year:
Landscape and Human Ecology:
Ecological structure of economy concerning geofactors; regional belts of the earth; interaction between ecosystems and working human beings.

Population:
Representation of processes concerning population; demographic structures and processes; limits of capacities.

Social and Economic Orders:
International economy; global interactions; alliances (EU and non-European alliances).

2nd Year.
Developing Countries:
Features; problems, development theories and strategies.

Industrial countries:

Sectoral change; urbanisation; economic regions; regional development and area development planning.

7. ECONOMY AND LAW

Training and Teaching Aims:
The student will
- be aware of the meaning of managerial economic considerations and concepts of political economy for the subject area.
- know legal regulations relevant to business administration and apprenticeship training.
- know the fundamentals of business accounting and contracting.
- know civic and constitutional principles and attitudes and be able to practise them.

Contents:
4th Year:
Political Economics:
Economic systems, Austrian economic order; production factors; market and price; money and currency; economic situation and growth; budget policy; income and consumption; foreign trade and balance of payment; international economy, European integration, bilateral economic relations, development aid.

Accounting:
Fundamentals of double entry book-keeping, internal index figures.

Law:
Outline of essential legal sectors. Fundamental concepts of the Civil Code with special focus on contracting business; payment transactions, cheque and exchange law. Basic concepts of trade law, environment law and European law.

5th Year:
Accounting:
Fundamentals of cost accounting (full and variable costing) in trade and industry. Controlling.

Labour Legislation and Social Law:
Basic concepts of labour legislation and social insurance law. Fundamentals of personnel accounting. Legal, pedagogic and psychological basics of apprenticeship training.

Management and Entrepreneurial Law:
Basics of planning and control, organisation; sale, supply, logistics, in-plant training and further education. Financing. Commercial law, insurances against possible risks, insolvency law, tax law.

Austrian Legal System and Federal Constitution:
Basic concepts of federal constitution (democratic, republican, constitutional state and federal principles, separation of powers). Parliament, federal government, federal president. Legislative of confederation and federal counties, administration (organisations, autonomous corporations), judicature (instances, legal proceedings), checks of public authority,(parliamentarian checks, supreme courts, people´s advocate, court of audit), written and practised constitution.

8. APPLIED MATHEMATICS

Training and Teaching Aims:
The student will
- know the mathematical terminology, theories and methods relevant to practice and further academic studies and will be able to apply them.
- be able to analyse basic facts and proceedings of nature, technology and economy and describe them by mathematical models, find model solutions and evaluate them.
- be able to employ mathematics as a tool for gaining information and for communication in business, engineering and science.
- be able to present mathematical concepts and demonstrate algorithms.
- be able to employ modern aids efficiently.

Contents:
1st Year:
Algebra:

Number systems; operations with variables and terms; vectors (representation, magnitude, addition, subtraction, multiplication by a scalar); linear equations and inequalities; solving of formulas, systems of linear equations.

Numerical Computations:
Representation of numbers; errors of representation; estimation of results.

Functions:
Concepts, representation in co-ordinate systems; linear function; evaluation of tables, interpolation; direct and inverse proportionalities.

Geometry:
Plane geometry (similarities; triangle, rectangle, circle; Pythagorean Theorems); stereometry; trigonometry of right triangles.

2nd Year:
Algebra and Geometry:
Vectors (dot product, orthogonality, vector product). Quadratic equations; exponential equations. Complex numbers (representation, operations). Trigonometry of the oblique triangle.

Functions:
Properties; inverse functions; quadratic functions, power and radical functions, exponential and logarithmic functions; general sine function, addition theorems, evaluation of functional graphs and functional equations; parametric representation.

Business Mathematics:
Compound interest calculations, linear optimisation.

Theory of Probability and Statistics:
Frequency distributions; characteristics; probability (addition and multiplication rules).

3rd Year:
Calculus:
Difference equations. Sequences, limits, continuity. Differentiation (difference and differential quotient, rules for differentiation, applications); integration (definite and indefinite integral, integration of elementary functions, applications). Functions of two variables, partial derivatives.

Numerical Mathematics:
Error approximation and propagation; problems of conditioning; numerical methods for the solution of equations and for the evaluation of definite integrals; interpolation.

4th Year:
Calculus:
Series of functions, (power series, Fourier series). Ordinary differential equations (simple first-order differential equations, differential equation for harmonic oscillation), integral transforms.

Linear Algebra and Analytic Geometry:
Matrices (operations and applications), determinants. Straight lines and planes; conic sections in central position. Algebraic structures.

5th Year:
Theory of Probability and Statistics:
Discrete and continuous distributions, inductive statistics (estimation of parameters, significance tests), correlation analyses (correlation, regression), statistical methods of quality management. Applications.

Current issues of applied mathematics with special focus on the subject discipline.

3st to 5th Years:
Specific applications of the discipline; use of practice-relevant calculation aids, computer aided assignments.

Four written tests in years with four respectively three weekly lessons; otherwise two.

9. APPLIED PHYSICS

Training and Teaching Aims.
The student will
- watch and describe processes in nature and relate them to special branches of physics.
- understand and apply physical methods and relate them to physical-technological assignments using (simple) mathematical symbols.
- be able to describe connections in words, in symbolic language and scientific terminology as well as graphically and in tables and formulas.
- be able to estimate dimensions and assess the plausibility of results.
- know and be able to apply the physical laws which are relevant to the production and application of materials, devices, machines, plants and processes commonly used in business practice. He will display a sound knowledge of technologies applied in energy utilisation and will be able to describe their effects on environment.
- know the modes of thinking and working of classical modern physics; he will be aware of the nature of conceptions of physical models and their limitations; he will further be able to comment critically on current scientific issues.

Contents:
1st Year:
General Physics:
Meaning and methods of physics; international units (SI- system)

Kinematics and Dynamics:
Velocity, acceleration, composite motions. Newton´s laws, force, work, energy, power, efficiency, momentum, conservation theorems of mechanics; rotation, central forces, gravitation.

Aeromechanics and Hydromechanics:
Pressure, buoyancy, flows. Molecular forces.

2nd Year:
Electricity and Magnetism:
Electric and magnetic field; mechanisms of conduction; magnetic characteristics; induction; electric circuits, energy supply.

Oscillations and Waves:
Oscillations and waves in mechanics, optics and electromagnetism,; resonance; wave propagation, standing waves, interferences, diffraction and scattering; modulation; acoustics.

Optics:
Reflection, refraction, total reflection, light velocity, imaging by optic systems. Diffraction at gap and grid, capacity of resolution of optic devices, interferences of thin layers, polarisation, photo elasticity, scattering.

Radiation:
Light and colours, spectra, emission and absorption of radiation; use of solar energy; laser; photometry, laws of temperature radiation.

3rd Year:
Thermodynamics:
Temperature; heat energy, heat transfer, thermal insulation; state equations of ideal gases (states of aggregation, temperature-concentration diagram); theorems of heat theory, gas kinetics, diffusion.

Fundamentals of Quantum Mechanics:
Wave-part-dualism, quantisation of energy, uncertainty principle, material waves.

Fundamentals of the Theory of Relativity:
Constancy of light velocity, equivalency of. mass and energy, space-time-continuum, experiments in thought.

Atomic and Nuclear Physics:
Structure of atoms and nuclei, radioactivity; fission, nuclear fusion, effects of radioactive radiation, radiation protection, applications of radioactive isotopes.

Energy Utilisation:

Technologies for energy utilisation and conversion; energy supply; entropy and ecological balance; energy budget of the earth.

10. APPLIED CHEMISTRY AND ECOLOGY

Training and Teaching Aims:
The student will
- observe and describe proceedings as well as phenomena of nature and technology and relate them to special branches of chemistry.
- know the concepts and methods applied in chemistry.
- be able to comment on current scientific issues.
- know the laws and methods of chemistry relevant to personal life and business practice and estimate dimensions; he will also display a knowledge in relevant chemical production and disposal technologies.
- show responsibility in the exploitation of materials by considering ecological and health factors.
- realise the opportunities and limitations of technological, economic and ecological assessments of products.
- recognise the meaning of soil, air, water and natural cycles as well as their changes caused by anthropogenous influences.
- know how to gain further information.

Contents:
1st Year:
Structures of Matter:
Pure substances, mixtures, elements, compounds, atomic models, nuclides, radioactivity, periodic system, chemical compounds, formula representation and nomenclature.

Chemical Reactions:
Reaction equations, energy budget, chemical balances, catalysis, stoichometry.

Types of Reactions:
Electrochemical series, Galvanic elements, electrolysis, corrosion, protection against corrosion.

Inorganic Basic Materials:
Production, use , cycles and residual utilisation.

Ecology:
Ecosphere and ecosystems (air, water, soil), cycles, balances, pollution, environmental protection.

2nd Year:
Carbon:
Bond types, modification, inorganic carbon compounds, (oxides, carbon acid), hydrocarbon, petroleum chemistry (petroleum, recovery, refining, products), hydrocarbon derivatives containing halogen, oxygen or nitrogen; macromolecules (natural substances and plastic materials), production, applications, residual utilisation.

Silicon:
Pure silicon, silicic acid, natural and technical silicates, organic silicon compounds, production, applications, residual utilisation, building materials.

Ecology:
Influence on ecosphere,(air, water, soil) in the surroundings of carbon and silicon processing plants, environmental analytics and measures of environmental protection in special examples.

11. DESCRIPTIVE GEOMETRY

Training and Teaching Aims:
The student will
- be able to identify the structure of an object represented in different views, evaluate the information of the drawing and make use of it in his design. He will also be able to sketch three-dimensional layouts by hand. He will further be able to identify geometrical forms of technical objects according to the requirements of the subject discipline and put them down in a construction drawing.

- be able to split construction processes into smaller units by using adequate models and develop algorithms for solution.
- be familiar with the generation of subject-relevant curves, area and solids and the laws governing them.
- be able to represent three-dimensional layouts in 3D on CAD-systems employing the standard software available at school.

Contents:
1st Year:
Three dimensional co-ordinate system.

Methods of projection.

Projection of geometrical and technical solids as well as axonometry for practice in recognising an object from different views.

Design in Related Orthogonal Projection:
Line segments and lines, plane figures and planes in central, projecting and general position; length of a line segment, size and shape of a plane figure; projection of a line and an area; orthogonal position of lines and area; intersections of objects with plane surfaces; circle in central, projecting and general position.

Orthogonal axonometry of objects with plane surfaces.

3D-Designs by means of CAD:
Fundamentals of areas of revolution; intersections planes and areas of revolution; penetration.

12. APPLIED COMPUTER SCIENCE

Training and Teaching Aims:
The student will
- know the set-up, functioning and range of applications of electronic processing systems and know how to operate them.
- select and employ standard software for the solution of business problems.
- will be able to solve basic practical problems by means of higher level programming languages.
- be able to retrieve and transfer information electronically.
- be aware of the effects of the information technologies on human society.

Contents:
1st Year:
Information Processing Systems
Configuration, function, interaction of the components, operating systems, operation.

Standard Software:
Word processing, sprea sheet calculations.

Programming:
Application of algorithms to basic problems. Transformation into programs.

2nd Year:
Program Design:
Methods of software design; structured programming, structure elements; data structures; objects.

Communication engineering:
Networks. Acquisition of information.

Standard Software:
Data base applications; graphics; interaction of software packages.

Computer Science and Society:
Effects of computer science; data protection.

13. FUNDAMENTALS OF MECHANICAL ENGINEERING

Training and Teaching Aims:
The student will
- know the materials and their properties which are most frequently used in electrical engineering.
- be familiar with the machines and their elements most frequently used in electrical engineering.
- be informed about mechanical-technical fundamentals of process engineering.
- be able to perform simple calculations.
- observe relevant regulations and standards.

Contents:
1st Year:
Materials in Electrical Engineering:
Iron, metals, non-metals (insulators, plastics).

Shaping:
Cutting and non-cutting shaping.

Connections:
Detachable, partly detachable and non-detachable connections.

Manufacturing Procedures of Precision Engineering:
Manufacture of printed circuit boards and electronic assembly groups.

2nd Year:
Fundamentals of Mechanics:
Statics (simple force systems, torque, conditions for equilibria, friction); kinetics (work, power, efficiency of straight line motion and rotary movements, inertia, energy theorem, impulse and twist theorems),basic mechanical calculations.

Science of the Strength of Materials:
Kinds of stress, simple calculations of strength.

Connections:
Detachable, partly detachable and non-detachable

Machine elements:
Shafts, bearings and couplings.

Machines:
Pumps and compressors, hoists, conveying means; applications in process engineering.

14. GENERAL ELECTRICAL ENGINEERING

Training and Teaching Aims:
The student will
- know the laws of electrical engineering
- be able to solve problems of electrical engineering

Contents:
1st Year:
DC Technology:
Electrochemical voltage sources, conductivity in metals, Ohmic resistances, Ohm’s law, Kirchhoff’s laws, circuit arrangements of resistances, power, efficiency, Joulean dissipation, equivalent sources (V/A-sources), power adaptation.

Magnetic Field:
Magnetic quantities, ferromagnetism.

2nd Year:
Magnetic Field:
Magnetic circuit; law of induction; energy and forces; inductivity.

Electrostatic Field:
Quantities, laws. Energy and forces; capacity.

AC Technology:
Elements of an AC circuit (resistance, capacitance, inductivity); impedance; complex representation, phasor diagrams; active, reactive and apparent power, losses, resonance.

Three-Phase System:
Three-wire and four wire systems, active, reactive and apparent power, rotary field.

Measurement Technology:
Terminology (errors, mean values, accuracy, sensibility,expansion of measuring range); measuring instruments for simple measurements of DC and single and three phase circuits; oscilloscopes.

Semiconductor Technology:
conductivity; structure; passive and active components; simple applications.

3rd Year:
Three-Phase System:
Symmetrical and unsymmetrical load, methods of calculation.

Non-Sinusoidal Quantities:
Closing and breaking of circuits with inductive and capacitive loads; harmonic oscillation, harmonic waves.

15. ELECTRONICS

Training and Teaching Aims:
The student will
- understand the function and dimensioning of basic electronic circuits.
- will be able to calculate the performance of more complex electronic circuits by using simplifying equivalent circuits or simulation.
- have a profound basic knowledge of electronics.

Contents:
3rd Year:
Electronic components:
Layout, function, characteristic and critical data, cooling and protection.

Circuitry:
Circuits with semiconductor components (rectifiers, voltage stabilisation, basic circuits for transistor amplifier).

Passive Filters:
Basic circuits, frequency characteristic.

System Theory:
Calculation of linear and non-linear networks; simulation.

4th Year:
Circuitry:
Amplifier and filter circuits; voltage and current sources; opto-electronics.

Industrial Circuitry:
Safety switches. electromagnetic interference and preventive measures; check and test routines.

16. DESIGN PRACTICE

Training and Teaching Aims:
The student will
- independently as well as in teams, be able to solve and document subject relevant layout assignments, using documents of business practice and considering the efficiency of manufacturing and quality assurance.

Contents:
1st Year:
Drawing of sketches of simple standard parts and subject relevant components.

Introduction to computer aided drawing and designing by means of industrial software.

2nd Year:
Improvement of already acquired skills in computer aided drawing and design.

Application of standard software to basic problems of relevant specialist areas.

17. LABORATORY

Training and Teaching Aims:
The student will
- be able to perform circuit, testing and measurement assignments independently and evaluate them by employing standard software.
- be able to select the most suitable methods and devices for each task considering both safety and accuracy requirements.

Contents:
3rd Year:
Practical training in major areas of the subject relevant compulsory subjects “General Electrical Engineering“ and “Electronics“.

Practical training in major areas of the compulsory subjects of the respective training focuses.

18. WORKSHOP-LABORATORY

Training and Teaching Aims:
The student will
- will be able to find and document technically correct solutions for measuring, test, maintenance and manufacturing problems which exceed the limits of workshop training and he will consider quality standards.
- will show an entrepreneurial attitude and behaviour when mastering challenging situations and profit from experience in project oriented teamwork.

Contents:
3rd Year:
Control Engineering:
Design of simple programs, connections, commissioning and test of programmable logic controllers of devices used in business practice including sensors and actors.

Wiring Installations in Buildings:
Structure and commissioning of installation systems. Lighting engineering.

Electronics:
Layout , testing and installation of electronic assembly groups and devices.

Electric Low-Voltage Systems:
Layout, error detection and removal, test and measurement tasks in electric systems. Checking of protective measures and measurement of earth resistance. Preparation of system relevant test protocols.

19. WORKSHOP

Training and Teaching Aims:
The student will
- be able to operate and maintain subject relevant facilities, tools, machines and equipment.
- be aware of the properties as well as the treatment and employment of materials and processing aids under special consideration of environmental aspects.
- will be able to manufacture subject relevant products according to designs and circuit diagrams.
- be capable of performing relevant practical jobs and analysing working processes and labour results in precise technical terminology.
- observe relevant safety rules.

Contents:
1st Year:
Workshop practice, workshop rules, general prevention of accidents (affecting all groups)

Basic Training in Electrical Engineering:
Wiring, connecting, visual recognition of electric components and component groups, measurement of current and voltage in electric components, soldering, connection techniques.

Basic Training in Electronics:
Visual recognition of electronic components, manufacture and assembly of simple electronic circuits; commissioning and test of these circuits, basic measurement tasks.

Electro-Installation:
Set-up, commissioning and performance test of electro-installations under special consideration of electrical and mechanical precaution measurements. Measurements of power consumers.

Basic Training in Mechanics:
Basic routines in the treatment and processing of relevant materials with a view to tolerances and quality standards employing machine tools.

2nd Year:
Plastic Engineering:
Manual treatment machining and processing of plastic materials. Surface treatment. Cast resin and adhesive technologies. Recycling of plastic materials.

Electromechanics:
Production and assembly of electric and electronic devices. Production and test of winding goods: and assembly of housing systems. Operation of machines and tools; program design for simple work routines of numerically controlled machine tools.

Electro-Installations:
Low-voltage installations and precaution measures. Layout, commissioning and test of wiring circuits.

Electronics:
Layout, commissioning and test of electronic circuits. Manufacture of printed circuit boards.

Connection Technique:
Thermic connection of relevant materials.

Electrical Machinery:
Winding and insulation processes for electrical machines and devices. Production of transformers and coils in power and communication engineering. Maintenance work.

3rd Year:
Electroinstallation:
Assembly and commissioning of low voltage systems considering precaution measurements.

Electronics:
Manufacture and commissioning of digital and analogue assembly groups, fault analysis and removal. Disentangling of prints by means of CAD. Printed circuit board and front panel manufacturing.

Open-Loop Control Engineering:
Layout, commissioning and test of open loop controls. Fault analysis and removal in open loop control systems.

Production preparation:
Time management, job orders, preparation of production documents by CAD. Programming of CNC machines.

B. COMPULSORY SUBJECTS OF SCHOOL– AUTONOMOUS SPECIAL TRAINING FOCUSES

B.1 POWER ENGINEERING AND INDUSTRIAL ELECTRONICS

1.1 MEASUREMENT TECHNOLOGY AND CONTROL ENGINEERING

Training and Teaching Aims:
The student will
- be able to solve problems in the area of automation engineering and process control engineering independently.
- be able to meet the requirements of system and realisation technology from recording electrical and non-electrical quantities to solving problems relevant in control engineering and the control of actors.
- know and observe relevant regulations, standards and presentations of process engineering.

Contents:
3rd Year:
Measurement Methods in Single and Three Phase Networks:
Rectification value, effective value, measurement of active and reactive power. Frequency measurements. Current and voltage transformers. Multiple range meters.

Sensor Technology:
Treatment of non-electrical quantities. Measurement transmission. Fundamentals of measurement amplifiers. Bridge circuits.

Fundamentals of Digital Technology:
Basic logic elements. Circuit networks, design, realisation, coding. Storages (flip-flops)

Applied Digital Technology:
Sequential logics, design, realisation. Programmable logic components. AD- and DA- converters. Layout of measuring circuits.

4th Year:
Industrial Open Loop Control Engineering:
Control structures, analysis and design of problems relevant in control engineering, programmable logic controllers. Actorics. Measuring bus systems. Field bus systems.

Closed Loop Control Engineering:
Fundamentals of closed loop control engineering. Elements of control loops and their mathematical representation (types, time and frequency response). Identification of controlled processes.

Control Loops:
Analogue control loops. Digital control loops. Control loops with discontinuous controllers. Meshed control loops. Analysis, stability, optimisation.

5th Year:
Controllers:
Analogue and digital realisation of controllers. Modern concepts for controllers.

Applications of Control Loops:
Control loops in drive system engineering. Analysis and realisation of industrial control loops.

1.2 ELECTRIC DRIVE SYSTEMS AND POWER ELECTRONICS

Training and Teaching Aims:
The student will
- have a sound knowledge of the structures, functions and performance of electrical machines and rectifiers.
- be capable of calculating and designing electric drives with a view to security and efficiency.
- know and observe relevant regulations and standards.
- consider quality assurance and electromagnetic compatibility.

Contents:
3rd Year:
Transformers:
Structure and performance of single and three-phase transformers, main dimensions, special makes.

DC Machines:
Structure and performance of generators and motors (adjustment of revolutional turns speed, starting retarding). Components of power electronics.

Line Connected Converters:
Phase angle control. Operation of AC and DCconverters, two way converters. System reaction, AC dividers

4th Year:
Rotational Field Theory:
Space Pointers, harmonic waves.

Induction Motors:
Structure (stator, rotor, windings). Performance (locus of current, operating range, current displacement, control, starting and retarding). Three phase dividers. Converter cascade.

Synchronous Machines:
Structure (stator, rotor, full-pole machine, salient pole machine, excitation systems). Performance of a full pole machine (island operation, mains powered). Converter feed motor.

5th Year:
Selfcommuted Power Converters:

DC choppers, frequency converters, structure with disconnectable power semiconductors (current converters, voltage converters, pulse converters)

Special Machines:
Single phase Motors, universal motors. Permanent magnet motors, disk-type rotor machine, linear motors, electronic motors (stepper motor).

Drive System Engineering:
Mechanic principles. Interaction of motor and drive. Determination of driving power of machines. Types of construction and modes of operation of electric machines. Types, heating, cooling, standardised loads.

1.3 ELECTRIC SYSTEMS

Training and Teaching Aims:
The student will
- have a sound knowledge of the structures, functions and performances of electric systems for the generation, distribution and application of electric energy as well as of respective precaution measurements.
- be equipped with the theoretical knowledge for the calculation, construction, assembly and operation of electric systems with a view to safety, economy and environment.
- know and observe relevant regulations and standards.
- consider quality assurance and electromagnetic compatibility.

Contents:
3rd Year:
Dimensioning of Electric Systems:
Laws, regulations, standards, criteria for dimensioning considering electric, mechanic and thermic stress, precaution measurements.

Electro-Installation:
Installation material, installations in buildings and special locations. Installation distributor, service lines, wiring schemes. Line protection (melting fuses, line protection circuit breakers, dimensioning, selectivity). Protective measures. Lightening protection devices and earthing electrodes.

Local Networks:
Cable and overhead transmission lines (types, standards, simple line calculations). Low voltage distribution systems (industrial, public).

Lighting Engineering:
Fundamentals, light-specific quantities and laws. Technical light sources. Guidelines for projecting and methods for the calculation of illumination systems.

Electric Heat:
Calculation of heat requirement. Industrial application.

4th Year:
Lines and Networks (Low and High Voltage):
Dimensioning of lines, voltage drop (load flow calculations by means of computers), calculations of short circuit current, short circuit proof, load carrying capacity, long distance lines. Types of overhead transmission lines and cables. Star-point treatment of networks, earth leakage fault, excess voltage protection and insulation co-ordination.

Low Voltage Switch Gears:
Basic circuits, dimensioning, devices, layouts. Compensation systems.

Switch Gears (Low and High Voltage):
Elimination of Voltaic arcs. Circuitry. Types of circuitry (Isolators, load disconnecting switches, power switches, fuses).

House Wiring
Heating, ventilation and air conditions . Monitoring systems for buildings. Installation bus systems.

5th Year:

Generation of Energy:
Technical possibilities for the generation of energy. Types of power plants (thermic, hydro electric power stations and nuclear power plants (principles and risks)). Parts of the power plants (water powered turbines, generation of steam (vessels, reactors)). Steam and gas turbines (survey), flue-gas precipitating equipment, cooling methods.

Alternative Sources of Energy:
Photo-voltaic cells, solar-thermic plants (principle); other regenerative forms of generating energy.

High Voltage Switch Gear:
Basic switching arrangements. Dimensioning (devices and other parts). Types (indoor, outdoor, SF_6).

Protection Techniques:
Problems, fault detection, principles and processes (analogue, digital). Special protection for devices (generator, motor, transformer, rectifiers). Mains protection.

Power System Operation:
Transmission stability, grids, high-voltage DC transmission. Electric power companies-power plant policy, system of tariffs.

Instrumentation and Control Engineering in Plants:
Basic structures of instrumentation and control engineering systems (power plants, transformer stations and networks - electricity, gas, water). Routing facilities in industry.

Electromagnetic Compatibility:
Fundamentals of interference and remedial measures. Rating and projecting with a view to electromagnetic compatibility. Demands on systems and devices according to relevant Federal Law Gazettes concerning electromagnetic compatibility, necessary measurings for CE-hallmarks.

1.4 ELECTRONICS AND MICROELECTRONICS

Training and Teaching Aims:
The student will
- be able to calculate the performance of more complex electronic circuits by developing simplifying equivalent circuits or simulations independently.

Contents:
4th Year:
Circuit Families:
Layout, characteristic values, coupling, examples for application.

Oscillation Generation:
Analogue and digital oscillation generation, modulation.

Power Electronics and Signal Processing:
Operation amplifier circuits for signal processing and signal matching. Layout and control of heavy current switches.

Software Engineering:
Specifications, modularisation, project organisation. Software test, documentation, calculation, time scheduling.

5th Year:
Microprocessor Engineering:
Computer architectures, bussystems. Microprocessor systems, microcontrollers, user programmable components. Multi-CPU-systems, signal processors, design and programming of microelectronic circuits. Personal computer hardware, interfaces.

Telecommunication Engineering:
Information technology (terminology, transmission media, coding, protection of messages). Computer networks (structure, installation, administration). Multi-computer systems (types, modems, network-node computers, network structures, protocols, data protection)

Periphery:
Addressing of peripheral components, data formats, transmission methods.

Computer Science for Processautomation:
Basic structures, programming methods, reliability of hard and software components, real time programming.

Software:
Visualisation and simulation software.

1.5 DESIGN PRACTICE

Continuation of compulsory subject “Design Practice“ of section A.

Training and Teaching Aims:
See section A.

The student will also
- be able to perform and document more complex, interdisciplinary projects from areas of the special training focus, considering efficiency and quality assurance.

Contents:
3rd Year:
Complex assignments and projects on issues treated in compulsory subjects “Electric Systems“ and “Electric Drive System Engineering and Power Electronics“ using industrial software.

4th Year:
More complex projects on issues treated in compulsory subjects “Electric Systems“, “Measurement Technology and Control Engineering“, “Electric Drive System Engineering and Power Electronics“ and “Electronics and Micro-electronics“ using industrial software.

5th Year:
Several interdisciplinary projects on issues treated in compulsory subjects “Electric Systems“, “Measurement Technology and Control Engineering“, “Electric Drive System Engineering and Power Electronics“ and “Electronics and Micro-electronics“ using industrial software.

1.6 LABORATORY

Continuation of compulsory subject “Laboratory“ of section A

Contents:
4th and 5th Years:
Practice in issues treated in compulsory subjects “General Electrical Engineering“, “Measurement Technology and Control Engineering“, “Electric Drive System Engineering and Power Electronics“, “Electric Systems“, and “Electronics and Micro-Electronics“.

Interdisciplinary projects in co-operation with compulsory subjects “Design Practice“ and “Workshop Laboratory“.

1.7 WORKSHOP-LABORATORY

Continuation of compulsory subject “Workshop-Laboratory“ of section A.

Contents:
4th Year:
Electric Machines and Drive Systems:
Selection and application of system-specific electric drives. Fault analysis. Test and measurement assignments for electric facilities.

Automation Engineering:
Layout, test and commissioning of open loop control and automation circuits by means of devices used in business practice.

Industrial Electronics:
Layout, test and commissioning of assembly groups of industrial electronics considering legal provisions and electromagnetic compatibility.

Operation Scheduling:
Analysis of work routines, rate settings, test and manufacturing devices, ergonometric aspects of work places. Monitoring and checking of time limits and test devices provided by quality management.

5th Year:
Electric Drive System Engineering:
Commissioning, optimising and test of rectifier circuits. Fault analysis of electric drive systems.

Automation Engineering:
Installation and commissioning of automation and closed-loop control systems. Digital and analogue processing of measuring quantities.

Process Control Engineering:
Visualising of process routines, commissioning of systems.

Industrial Electronics:
Commissioning, test and adjustment of electronic systems. Fault removal .

B.2 CONTROL ENGINEERING

2.1 MEASUREMENT TECHNOLOGY

Training and Teaching Aims:
The student will
- know electric and electronic instruments and processes relevant for the measurement of electric and non-electric quantities as well as their conversion and preparation for process automation.
- observe relevant regulations and standards.

Contents:
3rd Year:
Limiter Circuits:
Circuits for limiting measurement results, protection circuits.

AC Measurement Methods in Single and Three Phase Systems:
Measuring transducers, measurement of active and reactive power, power factors, energy; measurement of reactances; AC measuring bridges.

Operational Amplifiers:
Ideal and real operational amplifiers; basic circuits for operational amplifiers.

4th Year:
Measurement Amplifiers:
Circuits for operational amplifiers, instrument amplifier.

Transducers:
Definition, measuring chain, signal conditioning for providing standardised output values.

Sensor Technique:
Transducers for measuring non-electrical quantities, signal converters.

Electromagnetic Compatibility:
Factors and coupling methods, interferences (routing, earthing, and potential equalisation, screening and guard principle).

5th Year:
Sensor Technique:
Relevant sensors, measurement of quantities relevant in process engineering.

Telemetering:
Remote data transmission, information carrying parameter, band width and noise.

Digital Measurement Technology:
Fundamentals (signal analysis and correlation); instruments.

Measurement Procedures relevant for Electromagnetic Compatibility:
Standards, measuring instruments for line dependent and independent interferences.

2.2 OPEN- AND CLOSED-LOOP CONTROL ENGINEERING

Training and Teaching Aims:
The student will
- be familiar with instruments and methods for the control of physical quantities.
- identify technological processes and will be aware of different realisations of controls and automation processes.
- be able to treat control and automation assignments of complex systems and he will be capable of managing resulting hard and software problems.
- observe relevant regulations and standards.

Contents:
3rd Year:
Open Loop Control Engineering:
Fundamentals; design and simulation of hardware and software for combinatorial and sequential open loop controls; logic families.

4th Year:
Actorics:
Electromechanical actuators, pneumatics.

Closed Loop Control Engineering:
Terminology, description of systems in their time, frequency and Laplace convergence regions; stability, Selection of controllers for the process, quality criteria..

5th Year:
Closed Loop Control Engineering:
Identification, optimisation, simulation. Multi-quantity-controls.

Types of Controllers:
Continuous controls, discontinuous controls, digital closed loop systems, relevant closed loop systems. Interference immunity of closed loop control systems. Quality assurance in closed loop control systems.

2.3 DRIVE SYSTEM ENGINEERING AND ELECTRIC SYSTEMS

Training and Teaching Aims:
The student will
- know the types, functions and performances of electric machines, rectifiers and converters in order to employ them optimally in the areas of closed loop control and automation technology.
- be familiar with the functions and performances of relevant machines and prime movers in order to organise their interaction with electric machines.
- have a profound knowledge of precaution measurements and techniques and the corresponding regulations and standards in order to grant the safe employment of machines and devices.

Contents:
3rd Year:
Electro-Installation:
Standards and regulations, precaution measurements; lines and line protection, installation material; lightening protection devices, earthing electrodes; low voltage distribution systems.

Transformers, DC Machines:
Structure, function and performance.

Modes of Operation of Electric Machines
Standards and regulations, structures, types of protection, heating, cooling.

4th Year:
Rectifiers:
Layout, function and performance. Test and protection.

Induction Machine:
Rotational field theory, structure, performance and applications. Test and protection.

Converters:
Structure, performance, and application. Test and protection.. System reaction.

5th Year:
Synchronous Machine:
Structure, performance and applications. Test and protection.

Drive System Engineering:
Structure and performance of machines. Selection criteria for elctromotive drives; operating ranges; criteria for stability.

2.4 ELECTRONICS

Supplementation and continuation of the compulsory subject “Electronics“ of section A.

Contents:
4th Year:
See section A and forth.

Circuit Technology:
Oscillation and pulse generation; control switches in power engineering; DC-DC converters.

System Theory:
Switching processes in linear networks; spectra, modulation, demodulation, mixing; multiplex procedures.

5th Year:
Pulse Technique:
Transmission, processing; building-up transients and side-to-side crosstalks; electromagnetic compatibility.

Digital Signal Processing:
Fundamentals, filters, amplifiers.

2.5 PROCESS DATA TECHNOLOGY

Training and Teaching Aims:
The student will
- know the design and performance of microprocessors, process computers and computer networks.
- be competent in handling various programming tools by being trained to master different programming assignments.
- observe relevant regulations and standards.

Contents:
3rd Year:
Information Theory.
Fundamentals, data protection.

Microcontrollers:
Fundamentals, architecture, hardware.

Software:
Programming techniques, access to periphery; software solutions for technical open loop control problems.

4th Year:
Processor Systems:
Microprocessors; process peripherals.

Software:
Operating systems, real time operation. Software solutions to problems of measurement technology and control engineering.

5th Year:
Hardware:
System characteristics, selection criteria, reliability and availability.

Data Transmission:
Standardised bussystems, computer networks, visualising of processes; reliability and availability.

2.6 DESIGN PRACTICE

Continuation of compulsory subject “Design Practice“ of section A.

Training and Teaching Aims:
See section A.

The student will also
- be able to perform and document more complex, interdisciplinary projects from areas of the special training focus, considering the efficiency of manufacture, quality assurance and regulations concerning electromagnetic compatibility.

Contents:
3rd Year:
Fundamentals:
Design technique and design of devices, standards and regulations, development and design techniques, production documents. Dimensioning of parts of circuits and devices.

CAD:
Use of industrial software for the preparation of production documents. Computer aided development of circuits and circuit boards.

4th Year:
Projects:

Design, dimensioning and construction of projects on issues treated in subjects of the special training focus considering electromagnetic compatibility and using industrial software.

5th Year:
Projects:
Design, dimensioning and constuction of interdisciplinary projects on issues treated in subjects of the special training considering required power features and quality standards and using industrial software.

Design of circuits and assembly groups for analogue and digital circuits; simulation, programming.

2.7 LABORATORY

Continuation of compulsory subject "Laboratory" of section A

Training and Teaching Aims:
See section A.

The student will also
- be able to perform assignments in the area of control engineering, process data, simulation and visualisation technology and evaluate the results by means of computers.

Contents:
4th and 5th Years:
Practice in issues treated in compulsory subjects "General Electrical Engineering", "Electronics", "Measurement Technology", "Open- and Closed-Loop Control Engineering", "Electric Drive System Engineering and Power Electronics" and "Process Data Technology".

Interdisciplinary projects especially in co-operation with compulsory subjects "Design Practice" and "Workshop Laboratory".

2.8 WORKSHOP-LABORATORY

Continuation of compulsory subject "Workshop-Laboratory" of section A.

Contents:
4th Year:
Electric Machines and Drive Systems:
Selection and application of system specific electric drives. Fault analysis. Test and measurement assignments for electric facilities.

Automation Engineering:
Layout, test and commissioning of open loop control and automation circuits by means of devices used in business practice. Solution of problems by means of microcontroller systems.

Open Loop Control Engineering:
Solution of problems by means of programmable components; function control.

Operation Scheduling:
Analysis of work routines, rate settings, test and manufacturing devices, ergonometric aspects of work places. Monitoring and checking of time limits and test devices provided by quality management.

5th Year:
Electric Drive System Engineering:
Commissioning and test of rectifier circuits. Fault analysis of electric drive systems.

Closed Loop Control Engineering:
Commissioning and parametrization of industrial controls. Digital and analogue recording and processing of measurement values.

Process data Engineering:

Commissioning of systems for the aquisition, visualising and control of process routines.

Industrial Electronics:
Commissioning, test and adjustment of electronic systems considering legal provisions and electromagnetic compatibility. Fault removal .

MANDATORY WORK PLACEMENT

Training and Teaching Aims:
The student will
- be able to apply the knowledge and skills acquired in theory lessons and practical training programmes to actual business practice.

Organisation and Contents:
Mandatory work placement must last for at least eight weeks; it is advisable to split it into two four-week periods, however. The first part shall mainly comprise handicraft activities, while the second one should provide experience in engineering and business organisation. Preparation and review of mandatory work placement has to include issues on social and labour legislation.

The student has to hand in a mandatory work placement report to the head of the department documenting his activities and acquired skills.

C. OPTIONAL SUBJECTS, NON-OBLIGATORY PRACTICE AND TUTORIALS

C.1 OPTIONAL SUBJECTS

SECOND MODERN LANGUAGE

(French, Italian, Spanish, Serbo-Croatian, Hungarian). Compulsory subject English shall apply analogously.

COMMUNICATION AND PRESENTATION

Training and Teaching Aims:
The student will
- will know basic concepts of free speech, body language, discourse and discussion techniques.
- apply the rules of communication and discourse techniques to conversations and discussions.
- employ presentation aids efficiently.
- consider the basic concepts of communication concerning short speeches, job interviews, project presentation and discussions.

Contents:
1st to 5th Years:
Fundamentals:
Levels of Communication and Discourse. Conscious and unconscious transfer of information.

Discourse:
Basic discourse techniques, initiative. Preparation of discourse, argumentation; dealing with questions and delicate conversational situations. Job interviews.

Short Speeches:
Respiration and voice (respiration techniques, breathing exercises, speech intervals,; pronunciation and intonation. Speech exercises. Gestures and facial expression during the speech, eye contact, movements in space. Preparing and giving short speeches.

Presentation:
Disposition and structure; systematic preparation. Utilisation of presentation aids (charts, overhead, slides, computer aided presentation); preparation and organisation of project presentation.

Discussion:
Fundamental concepts (dynamics, routines, rules); dealing with questions and objections; preparation and organisation of discussions.

C.2 NON-OBLIGATORY PRACTICE

PHYSICAL EDUCATION

See Federal Law Gazette 37/1989

C.3 TUITIONS

Training and Teaching Aims:
Students who show a contemporary performance drop, but are principally qualified and prepared to work, will be provided with knowledge and skills needed to achieve training and teaching aims.

Contents:
Contents of the corresponding compulsory subject shall apply analogously; they are limited to repetitions and exercises.

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