Double Degree Master Program in Engineering Science

Agreement

between

Technische Universität Berlin

Str. des. 17. Juni 135, 10623 Berlin, Germany

and

Tomsk Polytechnic University
30, Lenin ave., 634050 Tomsk, Russian Federation

Preamble

The Technische Universität Berlin

– hereinafter referred to as "TUB" –

and

the Tomsk Polytechnic University

– hereinafter referred to as "TPU" –

establish herewith a Double Degree Master Program in Engineering Science

– hereinafter referred to as "DDMPES" –

The present agreement lays down the rights and obligations of the parties in arranging Master Studies during the DDMPES at the TUB and TPU.

I. General Regulations

I.1. The DDMPES results in the awarding of two degrees:

(a) Master Degree of Engineering and Technology with specialization in "Physics of High Technology in Mechanical Engineering" at the TPU

and

(b) Master of Science in "Engineering Science/Physikalische Ingenierwissenschaft" at the TUB.

I.2. The program shall have a shared curriculum. All program credits obtained will be recognized by both TUB and TPU.

I.3. The courses will be offered in German at TUB and in Russian or English at TPU. Projects and Master theses may be completed in English.

I.4. Following conditions must be fulfilled to enroll in the DDMPES:

a) Russian students:

(1) Four year bachelor at TPU or other Russian University of Technology in Mechanical Engineering or other relevant course of studies.

(2) Knowledge of German language of the medium level in accordance with the Goethe-Institute.

b) German students:

(1) Three year bachelor at a German University of Technology.

(2) Knowledge of Russian and English language of a level determined by TPU.

I.5. By enrolling in the DDMPES a personal study plan will be written and approved by both parties.

I.6. The studies structure is described in detail in the attachment to this agreement. It is to be approved by the academic council of the TPU and the examining board in Engineering Science of the Faculty V Mechanical Engineering and Transport Systems of the TUB. Amendments and changes in the program come into force after being coordinated and confirmed by the above bodies of the partner universities.

I.7. Responsibility for carrying out the Double Degree Master Studies and its development rests with the heads of the DDMPES of the both universities. These responsible persons are appointed by the faculty councils of the partner universities.

II. Master Studies Arrangements

II.1. The planned duration of the DDMPES will be 2 years. To earn the master's degree one should complete at least 120 credits according to the rules set forth in the program regulations attached to this agreement. At least 60 credits should be earned at the home university, and at least 60 credits at the partner university. For the duration of studies at the partner university, the students will be enrolled at the partner university according to the rules of the partner university and the DDMPES agreement.

II.2. Guest professorships are encouraged. Part of the courses may be taken during such guest professorships instead of a stay at the partner university. The guest lectures will be given in English. The awarding of honorary professorships to professors actively participating in DDMPES is strongly encouraged.

II.3. The DDMPES shall consist of the following categories:

- at least 18 credits advanced mathematical courses
- at least 24 credits + project (6 credits) in one of the strong points listed below
- at least 24 credits + project (6 credits) in the second one of the strong points listed below
- at least 12 elective credits in technical subjects
- at least 12 elective credits in non technical subjects
- Master thesis (18 credits at TUB and 24 credits at TPU).

The list of the strong points:

– numerics and simulation

– fluid dynamics

– mechatronics

– solid state mechanics

– thermodynamics

– technical acoustics

Courses assigned to particular categories or strong points are listed in module catalog. Advanced language courses may be chosen to fulfill 12 non-technical elective credits.

II.4. For each category of the DDMPES a module catalogue will be created. The modules descriptions provide in detail:

- the title of the course
- the responsible person and its address and E-mail
- the language
- the contents
- the qualification aims
- the workload calculation
- credit points
- qualification requirements for successful participation in the course

II.5. The master thesis shall be carried out according to the regulations of the university, where the thesis is written. Each student is to have two supervisors, one from each university. The master thesis may be written in German, Russian or English. The partner university is to receive an extended abstract of the thesis of about 4 pages in the language of the partner university.

III. Financial Commitments

III.1. The partner universities incur expenses connected with the preparation, carrying out of DDMPES, enrollment, and realization of the program.

III.2. Students incur expenses connected with traveling abroad (i.e. passport and visa costs, international transportation, health insurance, accommodation).

III.3. Partner universities may assist in arrangements connected with traveling abroad (student dormitories accommodation, bringing in of grants for the program).

III.4. Taking part in the DDMPES is free of charge for German students; it may or may not be free of charge for Russian students. In the case one university should charge fees, the partner university is to receive a dividend accordingly to the number of program credits completed at the partner university.

In the case that tuition is waived by both universities, students are still required to pay other university fees.

Berlin University of Technology	**Tomsk Polytechnic University**
Prof. Dr. Jörg Steinbach First Vice President	Prof. Dr. Yu.P. Pocholkov Rector
Tomsk, February 27, 2007	Tomsk, February 27, 2007

Double Degree Master Program in Engineering Science/Physikalische Ingenieurwissenschaft

of the Technische Universität Berlin

and

Tomsk Polytechnic University

Study Regulations

The following study regulations are drawn up in accordance with current study regulations for a degree in Engineering Science/Physikalische Ingenieurwissenschaft at the Faculty V Mechanical Engineering and Transport Systems of the Technische Universität Berlin, and the Double Degree Master Program in Engineering Science Agreement between Technische Universität Berlin (TUB) and Tomsk Polytechnic University (TPU) on 27.02.2007.

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I. General Regulations

§ I.1. Ambit

The following study regulations lay down, in connection with the examination regulations, the objectives, the content and the structure of Double Degree Master Program in Engineering Science (DDMPES) of TUB and TPU.

§ I.2. Course of Studies Description

Based on its mathematical-physical orientation, the DDMPES course of studies prepares for activity in research and development departments at firms and other institutions.
In an atmosphere emphasizing mathematical-physical principals as well as the application of analytical, numeric and experimental methods to practically orientated engineering tasks, graduates become prepared to approach new tasks flexibly and view them holistically. The existence of several study emphases allows students to build individually unique professional profiles.

Mathematical basics as well as two strong points from the fields

– numerics and simulation

– fluid dynamics

– mechatronics

– solid state mechanics

– thermodynamics

– technical acoustics

ensure the interdisciplinary and sound scientific base of this course.

Within the scope of projects the theoretical methods will be applied on a practical basis, where team-orientated and interdisciplinary ways of working play an important role. Furthermore the students may freely choose a number of courses and in this way reinforce their personal educational profile.

§ I.3. Goals

The DDMPES shall enable the students to develop mathematical-physical models for the technical systems as well as to investigate these models using the appropriate experimental, analytical and numerical methods. Thus the students should learn to recognize the standard mathematical approach to many diverse engineering issues.

On this basis goal-orientated solutions can be worked out by the students and integrated into complex systems by interdisciplinary teams. The independent way of scientific approach is imparted to the students during the studies, so that they may successfully analyze and work on innovative problem definitions in increasingly complex technical world.

A close connection between research and theory enables the students to learn to apply the latest research findings in engineering, supporting a project and team related way of working.

The students learn to act responsibly as well as investigate and assess critically their own and the others’ work.

The ability to impart specialist information in an interdisciplinary setting shall also be developed. The DDMPES offers students a strong foundation to be built upon by lifelong learning in the workplace.

§ I.4. Professional Fields of Activity

Through the combination of basic knowledge, methodical competence and interdisciplinary study the graduates are excellently prepared for work in research and development.

The operational area spans all trades where the innovative solutions and the latest scientific discoveries are gained and implemented into the products and services, e. g. automotive technology, aeronautical engineering, environment engineering, maritime systems, mechanical engineering and construction, energy economy, process engineering, bioengineering, medical technology, micro-mechanics and precision engineering.

§ I.5. Prerequisites and Enrollment

Following conditions must be fulfilled to enroll in the DDMPES:

a) Russian students:

(1) Four year bachelor at TPU or other Russian University of Technology in Mechanical Engineering,
(2) Knowledge of German language of the medium level in accordance with the Goethe-Institute.

b) German students:

(1) Three year bachelor at a German University of Technology,
(2) Knowledge of Russian and English language of a level determined by TPU.

By enrolling in the DDMPES a personal study plan will be written and approved by both parties.

§ I.6. Certification of Studies Length and Requirements

(1) The planned duration of the DDMPES is to be 2.5 years. To earn the master's degree one shall complete 120 credits according to § II.1. One half of these credits should be earned at the home university, the other half at the partner university.
(2) The graduate shall take a master degree exam. The precise details are outlined in the examination regulations.

§ I.7. Module Catalogue

(1) During the studies program the modules of the categories listed in § II.1 are to be fulfilled and a definite number of credit points according to European Credit Transfer System (ECTS) (§ I.8.) shall be achieved.

(2) One module contains, as a rule, several lectures/classes of different types and ends in an exam. The same lecture/class can not be credited in more than one module.
(3) Those are responsible for a particular module provide a description of this module in which the following aspects are described:

- Contents and qualification
- Teaching forms
- Classroom arrangements
- Conditions of participation
- Use of the module
- Workload
- Credit points and grades
- Conditions for awarding credit points
- Frequency of lectures and duration of the module

(4) The assignment of particular modules to the module groups as well as the form of examination, and the credit points assessment system are stated in the module list determined by both universities (see attachment). The examination boards of both universities may decide on changes to particular regulations within the module list. They may allow in individual cases the assignment of other modules to the one module group, if no study goals are changed.

§ I.8. Credit Points

(1) The period of time the students need to cover one study module is judged in credit points according to ECTS.
One credit point spread over one semester indicates the average working input of 30 working hours including participation in lectures/classes as well as private study, tests and examination preparation.
(2) In order to receive credit, students must fulfill the module classwork requirements as well as pass the final examination. Specific requirements are found in the module description.

§ I.9. Classroom Arrangements

(1) The course content is divided as follows:

1. Traditional lecture (VL). Subject material is presented by professor/lecturer.
2. Practice (UE). Practice serves to reinforce the material presented during lectures through examination of practical examples.
3. Tutorial (TUT). Tutorials serve to reinforce material presented during lectures through completing tasks in small work groups. The number of participants is limited to 15 students if possible.
4. Lab (PR). Lab consists of experimental exercises completed in small groups, in which the students are to learn handling and the suitable use of devices and instruments.
5. Integrated lectures/classes (IV). Integrated lecture entails of classroom arrangements occurring simultaneously without firmly predefined structure.
6. Project (PJ). Projects entail the planning and implementation process being realized in cooperative forms, on an interdisciplinary basis.
7. Seminar (SE). The teachers and students report on specific topics, which they then discuss a scientific basis.

8. Colloquium (CO). Colloquium prioritizes discussion between students and professors.

(2) The course catalogue which is issued once a semester gives information on the content of all lectures.

II. Structure of Studies

§ II.1. Structure of Studies

(1) The DDMPES shall consist of the following categories:
– 18 credits advanced mathematical courses
– 24 credits + project (6 credits) in one of the strong points listed below
– 24 credits + project (6 credits) in the second one of the strong points listed below
– 12 elective credits in technical subjects
– 12 elective credits in non technical subjects
– Master thesis (18 credits).

Advanced language courses may be chosen to fulfill 12 non-technical elective credits.

(2) The list of the strong points:

– numerics and simulation

– fluid dynamics

– mechatronics

– solid state mechanics

– thermodynamics

– technical acoustics

(3) Courses assigned to particular categories or strong points are listed in module catalog.

(4) Courses may be chosen from predetermined categories to fulfill a given credit total for each category. In the event that more courses are available in a category than required to fulfill the total, students may choose which courses are taken to fulfill the total.

(5) The master thesis shall be carried out according to the regulations of the university, where the thesis is written. Each student is to have two supervisors, one from each university. The master thesis may be written in German, Russian or English. The partner university is to receive an extended abstract of the thesis of about 4 pages in the language of the partner university.

III. Final Clauses

§ III.1. Commencement

The above study regulations are effective on the date the agreement on DDMPES is signed.

Double Degree Master Program in Engineering Science (DDMPES)

Module Catalogue

The DDMPES shall consist of the following categories:

- 18 credits advanced mathematical courses
- 24 credits + project (6 credits) in one of the strong points listed below
- 24 credits + project (6 credits) in the second one of the strong points listed below
- 12 elective credits in technical subjects
- 12 elective credits in non technical subjects
- Master thesis (18 credits).

Advanced language courses may be chosen to fulfill 12 non-technical elective credits.

The list of the strong points:

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2 strong points are to be chosen.
In each strong point, at least 24 credit points from advanced level 2 should be chosen, further 6 credit points shall be completed as a project.

Module group:	Assigned modules	Credits (according to ECTS)
Mathematical methods		**18**
Modules in Berlin		
	Tensor Analysis and Continuum Physics	6
	Numerics II for Engineers	6
or	Finite-Element-Method in Mechanics I	6
	Measurement and Control	
	Control Theory	9
	Variational Calculus and Optimal Control	5
	Stochastics for Computer Scientists	6
	Analysis III	6
	Integral Transformations and Partial Differential Equations	6
	Numerics I for Engineers	6
Modules in Tomsk		
	Elements of the Theory of Elasticity, Oscillations and Vibration Mechanics	4

Module Catalogue of the Strong Points

Numerics and simulation	**Assigned modules**	**Credits (according to ECTS)**
Modules in Berlin		
Core area (level 1)		
	Computational Fluid Dynamics CFD I+II	12
	Finite Element Methods 1	6
	Finite Element Methods 2	6
	Applied Information Technology	6
or	Industrial Information Technology	12
	Software Engineering	6
	Programming of Parallel and Distributed Systems	9
	Parallel Numerics	12
advanced courses (level 2)		
	CFD-Project (Applied Computational Fluid Dynamics (Project))	6
	Practical Training in Finite-Element-Method	6
	Seminar in Modeling	6
	Simulation and Measurement	12
	Numerical Linear Algebra	6
	Numerics of Elliptical Partial Differential Equations	6
	Statistical Turbulence Modeling	6
	Numerical Aeroacoustics (CAA)	12
	Technical Information Systems	6
	Information Systems Project	6
	OKS 1 - Basics (Fundamental Principles of Open Communication Systems)	6
and	OKS 3 - Practice (Advanced Communication Systems)	6
	OKS-Project (I or/and II)	6
	Fundamental Principles of Information Modeling	6
and	Databases (Database Systems)	6
	Picture Producing Process in Medicine and Neurobiology	6
	Algorithms of Image Processing	6
	Visualizing in Mathematics	10
	Picture Producing Process in Medicine I	6
	Industrial Image Processing	9
	Computer Graphics – Basics	6
	Computer Graphics – Completion	6
	Simulation of Production Systems - Work Place	
	Simulation of Production Systems - Material Flow	6
	Process and System Dynamics / Process Simulation	12
	Design and Simulation	12
	Numerical Simulation Methods in Engineering	6

	Communication Networks and Technology	12
	Modeling of Traffic Systems	8
	Modeling with Differential Equations I	10
	Control Theory	4
	Advanced Control Theory	9
	Neuronal Information Processing - Basics	9
	Neuronal Information Processing - Extension	9
	Linear Optimization	10
	Non-linear Optimization	10

Modules in Tomsk

	Information Technology in Science and Education	4
	Mathematical Methods of Experimental Data Processing	4
	Systems Analysis, Computer Modeling and Optimization in Mechanical Engineering	6
	Artificial Intelligence, Experimental Systems and Data Bases in Mechanical Engineering	6

Fluid dynamics	**Assigned modules**	**Credits (according to ECTS)**

Modules in Berlin

Core area (level 1)		
	Advanced Fluid Dynamics	6
	Turbulent Flows	12
	An Introduction to Computational Fluid Dynamics	12
	Fundamentals of Aeroacoustics	6
	Gasdynamics I	6
	Gasdynamics II	6
	Measurement Techniques in Fluid Dynamics	12
	Aerothermodynamics I	6
	Aerothermodynamics II	6
	Fluid System Dynamics	12
	Fluid Machinery	12
	Aerodynamics I	6
	Aerodynamics II	6
	Flow and Combustion in Gas Turbines	6
	Flow around Automobiles and Buildings	6
advanced courses (level 2)		
	Turbomachinery Noise	6
	Applied Computational Fluid Dynamics	6
	Modeling and Control of Combustion Systems: Thermal Acoustics	6
	Dimensional Analysis (Stability and Transition)	12
	Marine Hydrodynamics	12
	Process Engineering I	9
	Statistical Turbulence Modeling	6

	Computational Fluid Dynamics (CFD)	12
	Theoretical Acoustics (TA 8)	6
	Numerical Aeroacoustics (CAA)	6
	Supplement to Aeroacoustics	6
	Fluid-Borne Sound-Basics (TA 1 PI)	9
	Advanced Fluid-Borne Sound (TA 7)	6
	Flight Mechanics 2	6
	Numerical Simulation Methods in Engineering Science	6

Mechatronics	**Assigned modules**	**Credits (according to ECTS)**

Modules in Berlin

Core area (level 1)		
	System Dynamics and Mechatronics	6
	Measurement and Control	12
	Measurement Technology	12
	Electric Drives	6
	Drive Systems and Components	12
	Precision Mechanics and Micro Technology	12
or	Analog and Digital	6
	Embedded Real-time Systems	6
	Robotics (PDV 3)	6
	Theoretical Electrical Engineering	6
advanced courses (level 2)		
	Mechatronics in Industrial Application	3
	Measurement and Control - Completion	9
	Optimization Based Planning and Realization of Dynamic Processes	6
	Oil Hydraulics and Pneumatics 1	6
	Oil Hydraulics and Pneumatics 2	6
	Industrial Image Processing	9
	PDV / Robotics - Project	9
	Artificial Intelligence: Basis and Application	6
	Vibration Influence and Vibration Isolation in Machines Systems	6
	Flight Controlling	6
	Kinematics of Machinery Systems	6

Solid State Mechanics	**Assigned modules**	**Credits (according to ECTS)**

Modules in Berlin

Core area (level 1)		
	Contact Mechanics and Friction Physics	6
	Materials Science	6
	Mechanical Vibration Theory	6
	Finite Element Method - FEM I	6

	Finite Element Method - FEM II	6
	Fracture Mechanics I	6
	Fracture Mechanics II	6
	Project Finite Element Method	6
	Elasticity and Plasticity	6
	Vibration Influence and Vibration Isolation	6
	Dynamics of Power Train Systems	6
	System Dynamics and Mechatronics	6
	Introduction into the Vehicle Dynamics / Dynamics of Rail Vehicles	6
	Non-linear Continuum Mechanics	6
advanced courses (level 2)		
	Structure-Borne Sound (TA 5)	6
	Advanced Structure-Borne Sound (TA 9)	6
	Numerical Simulation Methods in Engineering Science	6
	Aeroelastics	6
	Non-linear and Chaotic Vibrations	6
	Rotor Dynamics	
	Flight Mechanics 2	6
	Flight Mechanics 3	6
	Contact Mechanics and Friction Physics	
Modules in Tomsk		
	Special Course of Mechanical Engineering Technology	6
	Automation and Control of Vacuum Equipment	4
	Methodology and Equipment of Experimental Investigations in Mechanical Engineering	4
	Physical Foundations of High-Temperature Technologies in Mechanical Engineering	6
	Special Technologies of Heat Treatment in Mechanical Engineering	4
	Production Methods of Special Heterophase and Heterogeneous Materials	6
	Physical Foundations of Designing and Producing of Hard Alloys for Mechanical Engineering	4
	Physical Foundations of Tribology	6
	Elements of the Theory of Elasticity, Oscillations and Vibration Mechanics	4

Thermodynamics	**Assigned modules**	**Credits (according to ECTS)**
Modules in Berlin		
Core area (level 1)		
	Irreversible Thermodynamics	
	Basic Thermic Operations	
	Theoretical Physics IV: Thermodynamics and Statistics	10
	Flow and Combustion in Gas Turbines	
	Combustion	
	Kinetic Theory	
	Statistical Physics	12
advanced courses (level 2)		
	Basics of Computational Fluid Dynamics (CFD 1+2)	

	Modeling and Control of Combustion Systems	6
	Low Temperature (Cryogenic) Thermodynamics	
	Phase Equilibrium in Multi-phase Systems	6
	Thermodynamics for Biological Systems	6
	Thermodynamics for Aggregating Systems	6
	Physical Chemistry III	
	Physical Chemistry IV	
	Gasdynamics I	
	Gasdynamics II	
Modules in Tomsk		
	Physical Foundations of High-temperature Technologies in Mechanical Engineering	6
	Special Technologies of Heat Treatment in Mechanical Engineering	4
	Production Methods of Special Heterophase and Heterogeneous Materials	6
	Physical Foundations of Designing and Producing of Hard Alloys for Mechanical Engineering	4

Technical Acoustics	**Assigned modules**	**Credits (according to ECTS)**
Modules in Berlin		
Core area (level 1)		
	Fluid-Borne Sound - Basics (TA 1 PI)	9
	Noise and Vibration Control (TA 2 PI)	9
	Measurement Technique and Signal Processing (TA 4)	6
	Structure-Borne Sound (TA 5)	6
	Fundamentals of Aeroacoustics	6
	Vibration Isolation and Vibration Control in Machines Systems	6
advanced courses (level 2)		
	Advanced Fluid-Borne Sound (TA 7)	6
	Theoretical Acoustics (TA 8)	6
	Aerodynamic Sound (TA 11)	6
	Advanced Noise and Vibration Control (TA 6 PI)	9
	Advanced Structure-Born Sound (TA 9)	6
	Supplementing Aeroacoustics	6
	Numerical Aeroacoustics (CAA)	6
	Flow and Combustion in Gas Turbines	6
	Modeling and Control of Combustion Systems (Thermoacoustics II)	6
	Statistical Energy Analysis (TA 10)	6
	Non-linear and Chaotic Vibrations	6
	Psychoacoustics, Noise Effects and Urban Noise Protection (TA 3)	12
Project	Acoustic Project	6
Nontechnical subjects:		
In Berlin:	Free selection from the whole study program of German universities:	

Modules in Tomsk

Topical Problems of Engineering Science	3
Methodology of Engineering Science	3
Methodology of Scientific Work	3
Philosophical Problems of the Natural Sciences, Humanities and Technology	3
Economic and Administration Problems in Mechanical Engineering: Problems of R&D Commercialization in Mechanical Engineering Management	3
	3
Foreign Language (Russian / German)	6

Double Degree Master Program in Engineering Science
Modules and courses provided by TPU

	Courses	Language	LP of course	LP of module
1st module: Scientific and philosophical problems in modern engineering				
1	Modern scientific problems in mechanical engineering	Russian	3	6
2	Methodology of science in mechanical engineering	Russian	3	
3	Methodology of scientific work	Russian	3	
4	Philosophical issues of natural sciences, humanities and engineering sciences	Russian	3	
2nd module: Economics and management				
5	Economic and administration problems in mechanical engineering: problems of R&D commercialization in mechanical engineering	Russian	3	3
6	Management	Russian	3	
3rd module: Russian language				
7 8	Russian language: General competence Russian language: Professional competence		6	6
4th module: Computer and information technology				
9	Information technology in science and education	Russian	4	8
10	Mathematical methods of experimental data processing	Russian / English	4	
5th module: Mechanical engineering technology				
11	Special course of mechanical engineering technology	Russian / English	6	10
12	Automation and control of vacuum equipment	Russian	4	
6th modul: Methodology of experimental research				
13	Methodology and equipment of experimental investigations in mechanical engineering	Russian / English	4	4
7th module: Modern process engineering				
14	Physical foundations of high-temperature technologies in mechanical engineering	Russian / English	6	10
15	Special technologies of heat treatment in mechanical engineering	Russian	4	
8th module: Physical principles of production and properties of special materials				
16	Production methods of special heterophase and heterogeneous materials	Russian / English	6	10
17	Physical foundations of design and production of hard alloys for mechanical engineering	Russian / English	4	
9th module: Intellectual systems				
18	System analysis, computer modeling and optimization in mechanical engineering	Russian	6	12
19	Artificial intelligence, experimental systems and data bases in mechanical engineering	Russian	6	
10th module: Special course in mechanics				
20	Physical foundations of tribology	Russian / English	6	10
21	Elements of the theory of elasticity, oscillations and vibration mechanics	Russian / English	4	
11th module: Research and development				
22	Research and development work (Project 1)		8	30
23	Research and development work (Project 2)		8	
24	Master's thesis		24	
		Total		111

Module Title **Scientific and Philosophical Problems in Modern Engineering**	Credits (ECTS) **6 ****	 **H** (Humanities)
***Module Overseer**:* **Department of Pphilosophy, TPU**		**Email:**
Module Description		

1. Course Goals
Engineering research organization; development of research-oriented problem solving skills in mechanical engineering; introduction of the culture of scientific thinking; reinforcement of basic intellectual processes (analysis, synthesis, summarization, classification, etc.). Competencies provided by module (%) specialized knowledge **70** methodological **15** system knowledge **15** social **0**

2. Contents
Science and technology trends; modern state of science in mechanical engineering; diversity of solution methods for research and engineering problems; scientific economical and organizational aspects of computer integrated industry; history and trends of science and technology development; systematization and mathematization of research; nature of scientific cognition, types and levels thereof; philosophy and methodology of science; notion of interdisciplinary relations in modern science; integration trends of modern cognition

3. Literature
Are printed scripts available? yes √, no □ Are electronic scripts available? yes □, no √ **Literature:** 1. Foundations of scientific research /Edit. Krutov V.I., Popov V.V. – M.: «Vischaya schkola», 1989. 2. Stepin V.S., Gorochov V.G., Rozov M.A. Philosophy of science and technology. – M.: Contact – Alfa, 1995. 3. Science philosophy and methodology. /Edit Kupzov V.I. – M.: «Aspect-Press», 1996.

4. Courses

Course Title	Classroom Format	Number of hours	ECTS credits		Semester (WS / SS) Winter or Summer
1. Modern scientific problems in mechanical engineering	Lecture	36	3		WS/any**
2. Methodology of science in mechanical engineering	Lecture	36	3		WS /any**
3. Methodology of research work	Lecture	36	3		SS/any**
4. Philosophical issues of natural sciences, humanities and engineering sciences	Lecture	36	3		WS/any**

5. Teaching Format
Lecture, practical training with the use of multimedia equipment

6. Prerequisites
None

7. Workload and Credits
Participation in lectures/classes: 36 h x 2 = 72 h Private study: 54 h x 2 = 108 h Tests and examination preparation: 20 h Total: 200 h** LP: 6

8. Examination Format
Oral or written test/exam

9. Module Duration
Achievable in 2 semesters

10. Number of Students
Minimum 2, maximum 20

11. Course Registration
-

**For German students

Module Title **Economics & Management**	Credits (ECTS) **3**	 **EB (Economics Block)**
Module Overseer: **Department of PhHTME, TPU** ***S. Psakhie***		**Email:** fvtm@tpu.ru
Module Description		

1. Course Goals

Acquaintance with basics of engineering enterprise management, organization and planning of production; acquisition of practical management skills for engineering work.

Competencies provided by module (%)
specialized knowledge **75** methodological competence
5 system knowledge **10** social competence **10**

2. Contents

Economic mechanism of an industrial enterprise; purposeful planning of breakeven business for an enterprise; technical basis of production; business-planning; current and operational planning at a corporation, marketing basics and quality management strategy.

3. Literature

Are printed scripts available? yes √, no □
Are electronic scripts available? yes □, no √

Literature:
Kozlovskii M.A. Industrial management.- M,: Infra, 2003.

4. Courses

Course Title	Classroom Format	Number of hours	ECTS credits		Semester (WS / SS) Winter or Summer
1. Economic and administration problems in mechanical engineering: problems of R&D commercialization in mechanical engineering	Lecture Practical training	18 18	3	optional	WS/any**
2. Management	Lecture Practical training	18 18	3	optional	WS/any**

5. Teaching Format

Lecture, practical training with the use of multimedia equipment

6. Prerequisites

a) obligatory: knowledge of basics of economics
b) desirable: none

7. Workload and Credits

Participation in lectures/classes: 36 h
Private study: 54 h
Tests and examination preparation: 15 h
Total: 105 h
LP: 3

8. Examination Format
Oral test/exam

9. Module Duration
Achievable in 2 semesters

10. Number of Students
Minimum 2, maximum 20

11. Course Registration
-

** for German students

Module Title **Russian Language**	Credits (ECTS) **3**	**Russian Language**
Module Overseer: **Department of Russian as a Foreign Language, TPU**		**Email:** rki@isc.tpu.edu.ru
Module Description		

1. Course Goals

Acquisition of language skills (reading, speaking, writing) for daily communication and studies

Competencies provided by module (%)
specialized knowledge **15** methodological competence **5**
system knowledge **50** social competence **30**

2. Contents

Russian language phonetics; typical scientific terms and constructions; word formation of parts of speech, composition of the word; Morphology: noun, adjective, verb, numeral, auxiliary parts of speech; Syntax: simple and complex sentence structure; reading comprehension of texts of different type; dialogic and monological speech; listening comprehension; generation of various written texts (report, article, plan, annotation, abstract, thesis).

3. Literature

Are printed scripts available? yes √, no □
Are electronic scripts available? yes □**,** no √

Literature:
Grekova O.K., Kuzminova E.A. Russian language as foreign. Discussing, writing thesis and abstract: Manual – M.: Flinta, 2003. – 296 p.

4. Courses

Course Title	Classroom Format	Number of hours	ECTS credits		Semester (WS / SS) Winter or Summer
1. Russian language: General competence	Practical training	220*	3		WS/any**
2. Russian language: Professional competence	Practical training	194*	3		WS/any**

5. Teaching Format

Practical training with the use of multimedia equipment

6. Conditions of Participation

a) obligatory: Russian language competence of the 1st Certification Level
b) desirable: none

7. Workload and Credits

Participation in lectures/classes: 514 h*
Private study: 272 h*
Tests and examination preparation: 30 h
Total: 816 h*
LP: 3

8. Examination Format
Oral and written exam on reading, speaking and writing

9. Module Duration
Achievable in 2 semesters

10. Number of Students
Minimum 2, maximum 20

11. Curse Registration
-

** for the German students only

Module Title **Computer & Information Technology**	Credits (ECTS) **8**	**CIT**
Module Overseer: **Department of PhHTME, TPU** ***V. Demidov***		**Email: fvtm@tpu.ru**
Module Description		

1. Course Goals

Review of modern computer technologies in science and education; acquaintance with basic methods of mathematical data processing; analysis and interpretation of experimental findings; acquisition of skills for experimental data processing with the use of modern universal software products (MathCAD).

Competencies provided by module (%)
specialized knowledge **70** methodological competence **15**
system knowledge **15** social competence **0**

2. Contents

Applied software packages and computer graphics; use of computers in research; computer-aided library and patent search; modern information technologies in education; latest technical methods of education; internet enhancement of research and education; conceptions of public and correspondence education; electronic training courses; Web-technology and XML-technology as basic platforms for the implementation of electronic training courses; statistical methods of experimental data analysis; least square method; empirical formulas for evaluation of experimental findings; numerical differentiation and integration; data interpolation.

3. Literature

Are printed scripts available? yes √, no □
Are electronic scripts available? yes √, no □
If yes, indicate the address: http://www.statsoft.ru/home/textbook/default.htm
Literature:

1. Brownlee K.A. Statistical theory and methodology in science and engineering. – John Wiley & Sons., New York – London – Sidney. (1965)
2. Kogalovskii M. R. Perspective information system technology. Ì.: DMK Press, 2003

4. Courses

Course Title	Classroom Format	Number of hours	ECTS credits		Semester (WS / SS) Winter or Summer
1. Information technology in science, engineering and education	Lecture Laboratory work	18 54	4		WS/any**
2. Mathematical methods of experimental data processing	Lecture Practical training	18 18	4		SS/any**

5. Teaching Format

Lecture, practical training with the use of multimedia equipment

6. Prerequisites

a) obligatory: knowledge of mathematics and basic informatics at the level of a standard higher education course; knowledge of probability theory and mathematical statistics, MathCad basics
b) desirable: knowledge of basic numerical methods, elements of discrete mathematics and programming

7. Workload and Credits	
1. Participation in lectures/classes: 36 h +18 h = 54 h Private study: 72 h Tests and examination preparation: 20 h Total: 164 h LP: 4	2. Participation in lectures/classes: 18 h +18 h = 36 h Private study: 108 h Tests and examination preparation: 20 h Total: 164 h LP: 4

8. Examination Format
Oral or written test/exam

9. Module Duration
Achievable in 2 semesters

10. Number of Students
Minimum 2, maximum 20

11. Course Registration
-

** for the German students only

Module Title **Mechanical Engineering Technology**	Credits (ECTS) **10**	**MET**
Module Overseer: **Department of PhHTME, TPU** ***V. Doljikov, I. Goncharenko***		**Email: fvtm@tpu.ru**
Module Description		

1. Course Goals

Notion of modern mechanical engineering production; basic principles of development, designing and automation of technological vacuum equipment; automated equipment operation skills, including vacuum equipment.

Competencies provided by module (%)
specialized knowledge **70** methodological competence **15**
system knowledge **15** social competence **0**

2. Contents

Modern intelligent production; CALS-technology; technological provision and improvement of operational characteristics of machine parts and their junctions; science intensive technology; conventional and unconventional methods of metal treatment; development of technological basis for automated assembly production; quality control; ISO 9000 Standards; foundations of design and exploitation of automated vacuum equipment; basic equation of vacuum machinery; standard schemes of vacuum systems.

3. Literature

Are printed scripts available? yes √, no □
Are electronic scripts available? yes □, no √

Literature:

1. Suslov A.G., Dalskii A.M. Scientific foundations of engineering technology. – M.: Mashinostroenie, 2002. – 684 p.
2. Poplavskii V.V. Technique of high vacuum / Manual. – Minsk, 2001. – 363 p.

4. Courses

Course Title	Classroom Format	Number of hours	ECTS credits		Semester (WS / SS) Winter or Summer
1. Special course on mechanical engineering technology	Lecture Laboratory work Practical training	36 18 18	6	optional	WS/any**
2. Automation and control of vacuum equipment	Lecture Laboratory work	18 18	4	optional	WS/any**

5. Teaching Format

Lecture, practical training and laboratory work with the use of computer, multimedia and laboratory equipment

6. Prerequisites

a) obligatory: basic knowledge of physics, physical chemistry and engineering technology
b) desirable: knowledge of technology of automated engineering industry

7. Workload and Credits	
1.Participation in lectures/classes: 36 h +18 h +18 h = 72 h Private study: 180 h Tests and examination preparation: 20 h Total: 252 h LP: 6	2. Participation in lectures/classes: 18 h +18 h = 36 h Private study: 108 h Tests and examination preparation: 20 h Total: 164 h LP: 4

8. Examination Format
Oral or written test/exam

9. Module Duration
Achievable in 2 semesters

10. Number of students
Minimum 2, maximum 20

11. Course Registration
-

** for the German students only

Module Title **Methodology of Experimental Research**	Credits (ECTS) **4**	 **MER**
Module Overseer: **Department of PhHTME, TPU** ***E.Korosteleva***		**Email:** fvtm@tpu.ru
Module Description		

1. Course Goals
Ability to plan, carry out and analyze results of experimental work Competencies provided by module (%) specialized knowledge **70** methodological competence **20** system knowledge **10** social competence **0**

2. Contents
Methods and equipment for investigation of material microstructure, macro- and microanalysis; methods and equipment for determining mechanical properties of materials, test modes, loading diagrams; major characteristics of materials.

3. Literature
Are printed scripts available? yes √, no □ Are electronic scripts available? yes □**,** no √ **Literature:** Materials science: methods of analysis, laboratory work and tasks: Manual / Yu. A. Geller, A. G. Rahstadt.—6 edition.—M.: Metallurgia, 1989.—456 p.—ISBN 5-229-00228-X.

4. Courses

Course Title	Classroom Format	Number of hours	ECTS credits		Semester (WS / SS) Winter or Summer
Methodology and equipment for experimental research in mechanical engineering	Lecture Laboratory work	18 18	4	optional	WS/any**

5. Teaching Format
Lecture, practical training with the use of special laboratory facilities and multimedia equipment

6. Prerequisites
a) obligatory: basic knowledge of chemistry, solid-state physics and physical material science b) desirable: none

7. Workload and Credits
Participation in lectures/classes: 36 h Private study: 54 h Tests and examination preparation: 20 h Total: 110 h LP: 4

8. Examination Format
Oral or written test/exam

9. Module Duration
Achievable in 1 semester

10. Number of Students
Minimum 2, maximum 20

11. Course Registration
-

** for the German students only

Module Title **Modern Process Engineering**	Credits (ECTS) **10**	**MPE**
Module Overseer: **Department of PhHTME, TPU** ***A.G. Knyazeva, O.V. Sizova***		**Email:** fvtm@tpu.ru
Module Description		

1. Course Goals

Notion of major thermal physics phenomena in technologies of high-temperature material treatment; solving of typical thermal physics problems; simulation of technological processes and their stages; physical nature and effects of processes in steel, e.g. laser treatment, iron implantation, heat treatment, etc.; relationship between structure and mechanical, physical and functional characteristics of steels.

Competencies provided by module (%)
specialized knowledge **80** methodological competence **15**
system knowledge **5** social competence **0**

2. Contents

Modern high-temperature technology; types of energy sources; major characteristics of heat exchange; heat transfer: thermal conductivity, convection and irradiation; mass exchange; thermal conductivity problems in different coordinate systems; complex heat exchange; heat transfer at melting and crystallization; heat exchange in systems with chemical reactions; alloying thermodynamics; phase and structural transformations in iron-based alloys; steel thermal treatment technology; surface hardening of steel by highly concentrated energy sources.

3. Literature

Are printed scripts available? yes √, no □
Are electronic scripts available? yes □**,** no √

Literature:

1. J.H.Lienhard IV, J.H. Lienhard V A heat transfer textbook / 2003, 760 P
2. M.I. Goldshtein, S.V. Grachev, Yu. G. Veksler. Materials science and heat treatment of metals. MISS, Moscow, 1999r. 408c.

4. Courses

Course Title	Classroom Format	Number of hours	ECTS credits		Semester (WS / SS) Winter or Summer
1. Physical foundations of high-temperature technologies in mechanical engineering	Lecture Lab	18 18	6	optional	SS/any**
2. Special technologies of heat treatment in mechanical engineering	Lecture Lab	18 18	4	optional	WS/any**

5. Teaching Format

Lecture, practical training with the use of special laboratory facilities, multimedia equipment and special software

6. Prerequisites
a) obligatory: knowledge of physics and higher mathematics, acquaintance with the MathCAD system; possession of basic knowledge of physical materials science and metal technology b) desirable: elements of mathematical physics and numerical methods

7. Workload and Credits
Participation in lectures/classes: 36 h x 2 = 72 h Private study: 54 h x 2 = 108 h Tests and examination preparation: 20 h Total: 200 h** LP: 6

8. Examination Format
Oral or written test/exam

9. Module Duration
Achievable in 2 semesters

10. Number of Students
Minimum 2, maximum 20

11. Course Registration
-

** for the German students only

Module Title **Physical Principles of Production and Properties of Special Materials**	Credits (ECTS) **10 ****	**MSB** (Materials Science Block)
Responsible for the Module: **Department of PhHTME, TPU** ***E.Korosteleva, I. Goncharenko, M. Lerner***		**Email: fvtm@tpu.ru**
Module Description		

1. Course Goals

Introduction to the modern production technology of heterogeneous and heterophase materials, including nanosized materials and hard alloys.

Competencies provided by module (%)
specialized knowledge **75** methodological competence **15**
system knowledge **10** social competence **0**

2. Contents

Heterophase and heterogeneous materials; polymorphism of materials; phase equilibrium; phase transition; heterogeneous reactions; modern production technologies of heterogeneous and heterophase materials; nanosized materials: nanoparticles, nanofibers, nanotubes, and nanowalls; structure of polymeric, biological, carbon and inorganic nanomaterials; thermodynamic, electronic, magnetic, and optical characteristics of nanomaterials; mechanical properties of heterogeneous materials; classification of hard alloys; main state diagrams of systems; technologies of hard alloy production; self-propagating high-temperature synthesis; wear-resistant coatings on hard alloys.

3. Literature

Are printed scripts available? yes √, no □
Are electronic scripts available? yes □**,** no √

Literature:

1. Andrievskii R. A., Ragulya A. V. Nanostructural materials: Manual for student.-M.: ACADEMIA, 2005.- 192 p.(russian)
2. Hard alloys / Edd. Kiffer R., Schwarzkopf P. –(german, russian) 1957. – 664 p.
3. A.G. Merzhanov. Self-distributing high-temperature synthesis. Modern problems. Physicheskaya himiya. M. «Himiya» 1983 г.(Russian)

4. Courses

Course Title	Classroom Format	Number of hours	ECTS credits		Semester (WS / SS) Winter or Summer
1. Production methods of special heterophase and heterogeneous materials	Lecture Laboratory work Course project	54 (36+18)	6	optional	WS/any**
2. Physical foundations of design and production of hard alloys for mechanical engineering	Lecture Laboratory work	36 (18+18)	4	optional	SS/any**

5. Teaching Format

Lecture, practical training with the use of special laboratory facilities and multimedia equipment

6. Prerequisites
a) obligatory: basic knowledge of physical materials science, physical chemistry b) desirable: none

7. Workload and Credits	
1.Participation in lectures/classes: 36 h +18 h = 54 h Private study: 52 h Tests and examination preparation: 20 h Total: 126 h LP: 6	2. Participation in lectures/classes: 18 h +18 h = 36 h Private study: 34 h Tests and examination preparation: 20 h Total: 90 h LP: 4

8. Examination Format
Oral or written test/exam

9. Module Duration
Achievable in 2 semesters

10. Number of Students
Minimum 2, maximum 20

11. Course Registration
-

** Only for German students

Module Title **Intellectual Systems**	Credits (ECTS) **12**	 **IS**
Module Overseer: **Department of PhHTME, TPU** ***N.L. Kozlikin***		**Email:** fvtm@tpu.ru
Module Description		

1. Course Goals

Notion of basic principles of a systematic approach to problem analysis, major types of models, modeling and optimization; Acquaintance with modern methodology of artificial intelligence (AI), its mathematical and philosophical aspects

Competencies provided by module (%)
specialized knowledge **70** methodological competence **15**
system knowledge **15** social competence **0**

2. Contents

Basic methods of system analysis; models and modeling of physical objects and processes; types of models: informational, mathematical and geometric (2D, 3D) models of human – computer interaction; single-/multiparameter optimization; basics of graph theory; linear and dynamic programming; methodology of artificial intelligence; mathematical and philosophical aspects of AI; design and use of AI systems; design tools for the development of intelligence systems: computer languages LISP, PROLOG, shells of expert systems; fields of AI application; knowledge and methods of AI representation; knowledge engineering, knowledgebase; processing methods of data structures; expert systems; deductive and inductive methods of drawing conclusions; artificial neural network.

3. Literature

Are printed scripts available? yes √, no □
Are electronic scripts available? yes □**,** no √

Literature:

1. Smit G. Mathematical and digital simulation for engineers and researchers. 1980. — 271 p.
2. Kochaner D., Mouler K., Nash S. Numerical methods and software support, 2001. — 575 p.
3. Luger D. Artificial intelligence. Strategy and solving methods of complex problems. Williams, 2003. — 864 p.

4. Courses

Course Title	Classroom Format	Number of hours	ECTS credits		Semester (WS / SS) Winter or Summer
1. System analysis, computer modeling and optimization in mechanical engineering	Lecture Practical training	18 18	6	optional	SS/any**
2. Artificial intelligence, experimental systems and databases in mechanical engineering	Lecture Practical training	18 18	6	optional	SS/any**

5. Teaching Format

Lecture, practical training with the use of multimedia equipment and special software

6. Prerequisites
a) obligatory: possession of intellectual operations (analysis, synthesis, summarizing, classification etc.) b) desirable: system approach to problem solving, development and analysis of models of physical objects and processes, search for optimal solutions

7. Workload and Credits
Class hours: 36 h x 2 = 72 h Homework: 54 h x 2 = 108 h Preparation for test: 20 h Total: 200 h** LP: 12

8. Examination Format
Oral or written test/exam

9. Module Duration
Achievable in 2 semesters

10. Number of Students
Minimum 2, maximum 20

11. Course Registration
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** for the German students only

Module Title **Special Course in Mechanics**	Credits (ECTS) **10**	**SM**
Module Overseer: **Department of PhHTME, TPU** ***A.V. Kolubaev, V.N. Demidov***		**Email:** fvtm@tpu.ru
Module Description		

1. Course Goals

Physical nature of processes in the friction contact area; mechanics and thermodynamics of friction, wear and lubrication; introduction to tribotechnical materials; acquaintance with modern theory of vibrations and vibrational mechanics; skills to solve applied problems in vibrations theory with the assistance of modern software (MathCAD).

Competencies provided by module (%)
specialized knowledge **75** methodological competence **15**
system knowledge **10** social competence **0**

2. Contents

Properties of frictional bodies and their surfaces; physical nature of friction; energy dissipation under friction; physical and chemical phenomena under friction; mechanical strengthening and weakening of solid surfaces under friction; laws of friction; technical systems with a finite number of degrees of freedom; elastic systems; conservative vibrating systems; dissipative systems; free and forced vibrations; parametric vibrations; self-oscillations; stochastic fluctuations; resonance; theory of stresses and strains in elastic media; dynamic problems of elastic theory; vibrations of typical elements of technical systems; variational and finite-difference methods in the theory of vibrations.

3. Literature

Are printed scripts available? yes √, no □
Are electronic scripts available? yes □, no √

Literature:

1. Timoshenko S.P., Gudier J. Elasticity theory. – M.: Nauka, 1979.
2. Strelkov S.P. Intrduction to theory of vibrations. St.-Ptsb., Lan, 2005.

4. Courses

Course Title	Classroom Format	Number of hours	ECTS credits		Semester (WS / SS) Winter or Summer
1. Special course on the physical basics of tribology	Lecture Laboratory work	18 18	6	optional	SS /any**
2. Elements of the theory of elasticity, oscillations and vibrational mechanics	Lecture Practical training	18 18	4	optional	SS /any**

5. Teaching Format

Lecture, practical training with the use of multimedia equipment and special software

6. Prerequisites
a) obligatory: knowledge of physics, mathematics and theoretical mechanics at the level of a standard higher education course, acquaintance with the MathCAD system; b) desirable: basic knowledge of physical materials science and continuum mechanics, elements of computational mathematics and programming.

7. Workload and Credits
Participation in lectures/classes: 36 h x 2 = 72 h Private study: 54 h x 2 = 108 h Tests and examination preparation: 20 h Total: 200 h** LP: 6

8. Examination Format
Oral or written test/exam

9. Module Duration
Achievable in 1 semester

10. Number of Students
Minimum 2, maximum 20

11. Course Registration
-

** for the German students only