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:
- numerics and simulation
- fluid dynamics
- mechatronics
- solid state mechanics
- thermodynamics
- technical acoustics

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.

<table>
<thead>
<tr>
<th>Module group:</th>
<th>Assigned modules</th>
<th>Credits (according to ECTS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical methods</td>
<td></td>
<td>18</td>
</tr>
</tbody>
</table>

**Modules in Berlin**

- Tensor Analysis and Continuum Physics 6
- Numerics II for Engineers 6
- Finite-Element-Method in Mechanics I 6
- 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 6
# Module Catalogue of the Strong Points

## Numerics and simulation

<table>
<thead>
<tr>
<th>Assigned modules</th>
<th>Credits (according to ECTS)</th>
</tr>
</thead>
</table>

### Modules in Berlin

#### Core area (level 1)*

- Computational Fluid Dynamics CFD I+II
- Finite Element Methods 1
- Finite Element Methods 2
- Applied Information Technology

or

- Industrial Information Technology
- Software Engineering
- Programming of Parallel and Distributed Systems
- Parallel Numerics

#### advanced courses (level 2)**

- CFD-Project (Applied Computational Fluid Dynamics (Project))
- Practical Training in Finite-Element-Method
- Seminar in Modeling
- Simulation and Measurement
- Numerical Linear Algebra
- Numerics of Elliptical Partial Differential Equations
- Statistical Turbulence Modeling
- Numerical Aeroacoustics (CAA)
- Technical Information Systems
- Information Systems Project
- OKS 1 - Basics (Fundamental Principles of Open Communication Systems)

and

- OKS 3 - Practice (Advanced Communication Systems)
- OKS-Project (I or/and II)
- Fundamental Principles of Information Modeling
- Databases (Database Systems)
- Picture Producing Process in Medicine and Neurobiology
- Algorithms of Image Processing
- Visualizing in Mathematics
- Picture Producing Process in Medicine I
- Industrial Image Processing
- Computer Graphics – Basics
- Computer Graphics – Completion
- Simulation of Production Systems - Work Place
- Simulation of Production Systems - Material Flow
- Process and System Dynamics / Process Simulation
- Design and Simulation
- Numerical Simulation Methods in Engineering
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

<table>
<thead>
<tr>
<th>Assigned modules</th>
</tr>
</thead>
<tbody>
<tr>
<td>credits</td>
</tr>
</tbody>
</table>

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
### Mechatronics

<table>
<thead>
<tr>
<th>Assigned modules</th>
<th>Credits (according to ECTS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core area (level 1)*</td>
<td></td>
</tr>
<tr>
<td>System Dynamics and Mechatronics</td>
<td>6</td>
</tr>
<tr>
<td>Measurement and Control</td>
<td>12</td>
</tr>
<tr>
<td>Measurement Technology</td>
<td>12</td>
</tr>
<tr>
<td>Electric Drives</td>
<td>6</td>
</tr>
<tr>
<td>Drive Systems and Components</td>
<td>12</td>
</tr>
<tr>
<td>Precision Mechanics and Micro Technology</td>
<td>12</td>
</tr>
<tr>
<td>Analog and Digital</td>
<td>6</td>
</tr>
<tr>
<td>Embedded Real-time Systems</td>
<td>6</td>
</tr>
<tr>
<td>Robotics (PDV 3)</td>
<td>6</td>
</tr>
<tr>
<td>Theoretical Electrical Engineering</td>
<td>6</td>
</tr>
<tr>
<td><strong>or</strong></td>
<td></td>
</tr>
<tr>
<td>Contact Mechanics and Friction Physics</td>
<td>6</td>
</tr>
<tr>
<td>Materials Science</td>
<td>6</td>
</tr>
<tr>
<td>Mechanical Vibration Theory</td>
<td>6</td>
</tr>
<tr>
<td>Finite Element Method - FEM I</td>
<td>6</td>
</tr>
</tbody>
</table>

### Advanced courses (level 2)**

<table>
<thead>
<tr>
<th>Assigned modules</th>
<th>Credits (according to ECTS)</th>
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<tbody>
<tr>
<td>Mechatronics in Industrial Application</td>
<td>3</td>
</tr>
<tr>
<td>Measurement and Control - Completion</td>
<td>9</td>
</tr>
<tr>
<td>Optimization Based Planning and Realization of Dynamic Processes</td>
<td>6</td>
</tr>
<tr>
<td>Oil Hydraulics and Pneumatics 1</td>
<td>6</td>
</tr>
<tr>
<td>Oil Hydraulics and Pneumatics 2</td>
<td>6</td>
</tr>
<tr>
<td>Industrial Image Processing</td>
<td>9</td>
</tr>
<tr>
<td>PDV / Robotics - Project</td>
<td>9</td>
</tr>
<tr>
<td>Artificial Intelligence: Basis and Application</td>
<td>6</td>
</tr>
<tr>
<td>Vibration Influence and Vibration Isolation in Machines Systems</td>
<td>6</td>
</tr>
<tr>
<td>Flight Controlling</td>
<td>6</td>
</tr>
<tr>
<td>Kinematics of Machinery Systems</td>
<td>6</td>
</tr>
</tbody>
</table>

### Solid State Mechanics

<table>
<thead>
<tr>
<th>Assigned modules</th>
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<tbody>
<tr>
<td>Core area (level 1)*</td>
<td></td>
</tr>
<tr>
<td>Contact Mechanics and Friction Physics</td>
<td>6</td>
</tr>
<tr>
<td>Materials Science</td>
<td>6</td>
</tr>
<tr>
<td>Mechanical Vibration Theory</td>
<td>6</td>
</tr>
<tr>
<td>Finite Element Method - FEM I</td>
<td>6</td>
</tr>
</tbody>
</table>
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 6
Flight Mechanics 2 6
Flight Mechanics 3 6
Contact Mechanics and Friction Physics 6

**Modules in Tomsk**
Special Course of Mechanical Engineering Technology 6
Automation and Control of Vacuum Equipment 6
Methodology and Equipment of Experimental Investigations in Mechanical Engineering 6
Physical Foundations of High-Temperature Technologies in Mechanical Engineering 6
Special Technologies of Heat Treatment in Mechanical Engineering 6
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 6

**Thermodynamics**

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**Modules in Berlin**

<table>
<thead>
<tr>
<th>Core area (level 1)*</th>
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<tbody>
<tr>
<td>Irreversible Thermodynamics</td>
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<tr>
<td>Basic Thermic Operations</td>
</tr>
<tr>
<td>Theoretical Physics IV: Thermodynamics and Statistics 10</td>
</tr>
<tr>
<td>Flow and Combustion in Gas Turbines</td>
</tr>
<tr>
<td>Combustion</td>
</tr>
<tr>
<td>Kinetic Theory</td>
</tr>
<tr>
<td>Statistical Physics 12</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>advanced courses (level 2)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basics of Computational Fluid Dynamics (CFD 1+2)</td>
</tr>
</tbody>
</table>
Modeling and Control of Combustion Systems 6
Low Temperature (Cryogenic) Thermodynamics 6
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 6
Production Methods of Special Heterphase and Heterogeneous Materials 6
Physical Foundations of Designing and Producing of Hard Alloys for Mechanical Engineering 4

Technical Acoustics

<table>
<thead>
<tr>
<th>Assigned modules</th>
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</tr>
</thead>
</table>

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: 3
- Problems of R&D Commercialization in Mechanical Engineering: 3
- Management: 3
- Foreign Language (Russian / German): 6

* Level 1 corresponds to the level 5 of TPU

** Level 2 corresponds to the level 6 of TPU