



Module guide

International Master Program

Cardiovascular Science

University of Göttingen

Part 1

Theoretical modules

Synopsis

The Master program **Cardiovascular Science** contains four theoretical modules (M.CVS.101; M.CVS.102, M.CVS.201, M.CVS.301) with a consecutive curriculum covering basic knowledge on the organ and molecular level of the cardiovascular system, on cardiovascular diseases and therapies as well as on modern aspects of cardiovascular science. In addition, this curriculum is accompanied by the module M.CVS.004 which includes the training and attendance of presentations of recent topics in cardiovascular research.

M.CVS.101: Cardiovascular Basics I

M.CVS.001: Lab rotation I

M.CVS.102: Cardiovascular Basics II

M.CVS.002: Lab rotation II

M.CVS.201: Cardiovascular diseases and therapies

M.CVS.301: Cardiovascular research in academia and industry

M.CVS.003: Lab rotation III

M.CVS.004: Modern topics in CVS and clinical research

Georg-August-University Göttingen Module M.CVS.101: Cardiovascular basics I	9 ECTS 7 SWS
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Learning outcomes Students who have successfully finished this module have an advanced knowledge of: 1.) The anatomy of the heart, the vasculature, the lung, the kidney, the nervous system of humans, rodents and widely used experimental animals (e.g. zebra fish) 2.) The embryonic development in general and of the cardiovascular system 3.) The physiology of the heart, the circulation, the lung, the kidney, the autonomous nervous system including e.g. detailed knowledge on the control of cardiac contractility and function, the short and long term control of the blood pressure, important hemodynamic laws 4.) The hormonal control of the cardiovascular system e.g. by catecholamines, the RAAS, natriuretic peptides, sex hormones	Total hours Contact hours 98 h Self-study 172 h
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Courses 1. Cardiovascular basics I (Lectures, 70h) <i>Content</i> <ul style="list-style-type: none"> • Cardiovascular anatomy • Cardiovascular embryology • Cardiovascular physiology • Cardiovascular nervous system • Cardiovascular endocrinology • 	5 SWS
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Examination: Written exam (120 min) about the development, physiology and anatomy of the heart and the cardiovascular system and its hormonal and nervous regulation.	
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2. Cardiovascular basics I (Practical course, 28h) <i>Content</i> <ul style="list-style-type: none"> • The cardiovascular anatomy • Histology course of cardiovascular tissues • Cardiovascular Physiology 	2 SWS
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Examination Seminar presentation (oral, 15 min): Short PowerPoint presentation about a given topic, including max. 5 minutes discussion	
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Entry requirement None	Recommended pre-requisites None
Language English	Module coordinator Dr. Laura Zelarayan-Behrend
Frequency Each winter semester	Duration 7 weeks
Repeatability twice	Recommended semester of study 1
Maximal number of students 25	

Additional notes and regulations: - Teaching capacity provided by: Med-VK: 54h lecture, 28h practical work; Med-KT: 16h lecture; Med.-K:-
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Georg-August-University Göttingen Module M.CVS.102: Cardiovascular basics II	9 ECTS 7 SWS
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<p>Learning outcomes</p> <p>Students who have successfully finished this module have an advanced knowledge of:</p> <ol style="list-style-type: none"> 1.) The detailed structure of eukaryotic cells and especially of cardiovascular cells including cardiomyocytes, smooth muscle cells, endothelial cells, fibroblasts, epithelial cells, stem cells 2.) Important cellular processes e.g. proliferation, migration, contraction, apoptosis, necrosis 3.) Intracellular mechanisms e.g. transcription, translation, PTM, exo/endocytosis, protein degradation 4.) The regulation of action potentials, ion fluxes, transporters 5.) Thermodynamics, hydrodynamics, biomechanics 6.) The cellular metabolism including glucose, fatty acid and amino acid metabolism 7.) Protein composition and structures 8.) The genetic and epigenetic control of protein expression including the DNA architecture, replication, transcription, DNA modifications, histon modifications 9.) Import concepts of signal transduction including membrane and intracellular receptor-dependent signaling involving e.g. kinases-phosphatases, G proteins, second messengers, transcription factors, oxygen and redox signaling 	<p>Total hours</p> <p>Contact hours 98 h</p> <p>Self-study 172 h</p>
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<p>Courses</p> <p>1. Cardiovascular basics II (Lectures, 84h)</p> <p><i>Content</i></p> <ul style="list-style-type: none"> • Cardiovascular cell biology • Cardiovascular biophysics • Cardiovascular biochemistry • Cardiovascular (epi)genetic • Cardiovascular signal transduction 	6 SWS
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<p>Examination</p> <p>Written exam (120 min) about the function of different sources of cell types, important biochemical and biophysical cellular processes, signal transduction processes in the heart and basics of (epi)genetics</p>	
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<p>2. Cardiovascular basics II (Seminar, 14h)</p> <p><i>Content:</i> Presentation of recent publications from the cardiovascular field.</p>	1 SWS
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<p>Examination</p> <p>Seminar presentation (oral, 15 min): Short PowerPoint presentation about a given topic, including max. 5 minutes discussion</p>	
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Entry requirement None	Recommended pre-requisites Passed examination in module M.CVS.101
Language English	Module coordinator Dr. Xingbo Xu
Frequency Each winter semester	Duration 7 weeks
Repeatability Twice	Recommended semester of study 1
Maximal number of students 25	

<p>Additional notes and regulations: -</p> <p>Teaching capacity provided by:</p> <p>Med-VK: 20h lecture, 4h seminar; Med-KT: 30h lecture, 6h seminar; Med.-K: 34h, 4h seminar</p>

Georg-August-Universität Göttingen Module M.CVS.201: Cardiovascular diseases and therapies	9 ECTS 7 SWS
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<p>Learning outcomes</p> <p>Students who have successfully finished this module have an advanced knowledge of:</p> <ol style="list-style-type: none"> 1.) Etiology and pathophysiology, signs and symptoms, diagnosis, classifications, management, prognosis of important cardiovascular diseases including e.g. coronary artery disease, load-dependent heart diseases, cardiomyopathies, myocarditis, pulmonary heart diseases (PAH and COPD), arrhythmia and their outcomes e.g. myocardial infarction, stroke, left and right heart failure 2.) Risk factors for heart diseases including diabetes, hypertension, metabolic syndrome 3.) Important molecular causes for cardiovascular diseases including involved gene mutations and disease-dependent molecular changes 4.) Important technologies in cardiovascular imaging including echocardiography, computed tomography, magnetic resonance imaging 5.) Treatment strategies and basic pharmacological principles including pharmacodynamics, pharmacokinetics, interference with the catecholamine, acetylcholine and RAA systems, diuretics, anti-arrhythmic drugs, vasodilators, lipid-lowering drugs, anti-thrombotic drugs, anti-diabetic drugs 6.) Modern (experimental) therapeutic approaches including gene therapy, cell-based therapy, tissue regeneration 7.) Interventional therapies including coronary catheterization, stent implantation 8.) Cardiac surgeries of acquired heart diseases, of the vasculature and congenital heart defects including heart and valve transplantation, by-pass surgery. 	<p>Total hours</p> <p>Contact hours 98 h</p> <p>Self-study 172 h</p>
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<p>Courses</p> <p>1. Cardiovascular diseases and therapies (Lecture, 84h)</p> <p><i>Content</i></p> <ul style="list-style-type: none"> • Clinical and molecular aspects of cardiovascular diseases in adults and children • Cardiovascular imaging • Interventional therapies & Cardiovascular surgery • Cardiovascular pharmacology 	6 SWS
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<p>Examination</p> <p>Written exam (180 min) the diagnosis of cardiovascular diseases via imaging and their pharmacological and interventional therapies, clinical aspects of cardiovascular diseases in adults and children</p>	
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<p>2. Cardiovascular basics II (Seminar, 14h)</p> <p><i>Content:</i> Presentation of recent publications from the cardiovascular field.</p>	1 SWS
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<p>Examination</p> <p>Seminar presentation (oral, 15 min): Short PowerPoint presentation about a given topic, including max. 5 minutes discussion</p>	
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Entry requirement None	Recommended pre-requisites Passed exam in module M.CVS.101 and 102
Language English	Module coordinator Prof. Susanne Lutz
Frequency Each summer semester	Duration 7 weeks
Repeatability Twice	Recommended semester of study 2
Maximal number of students 25	

<p>Additional notes and regulations: - Teaching capacity provided by: Med-VK: -; Med-KT: 28h lecture; Med.-K: 56h lecture, 14h practical work</p>

Georg-August-Universität Göttingen Module M.CVS.301: Cardiovascular research in academia and industry	9 ECTS 7 SWS
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Learning outcomes Students who have successfully finished this module have an advanced knowledge of: 1.) Specified topics of current cardiovascular research 2.) State of the art methodology in cardiovascular research 3.) Biostatistics 4.) Principles in molecular microscopy in medicine 5.) The design and management of clinical trials 6.) Research standards in industry	Total hours Contact hours 98 h Self-study 172 h
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Courses 1. Cardiovascular research in academia and industry (Lecture, 84h) <i>Content</i> <ul style="list-style-type: none"> • Scientific aspects of cardiovascular diseases • State-of-the art research methods • Biostatistics • Principles in microscopy • Design and management of clinical trials • Insights in research in industry 	6 SWS
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Examination Written exam (180 min) basics of biostatistical methods and the management and design of clinical trials, different state-of-the-art methods and high throughput technologies in cardiovascular research	
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2. Cardiovascular research in academia and industry (Seminar, 14h) <i>Content</i> Presentation of recent publications from the cardiovascular field.	1 SWS
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Examination Seminar presentation (oral, 15 min): Short PowerPoint presentation about a given topic, including max. 5 minutes discussion	
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Entry requirement None	Recommended pre-requisites Passed examinations in modules M.CVS.101, M.CVS.102 and M.CVS.201
Language English	Module coordinator Dr. Tim Meyer
Frequency Each winter semester	Duration 7 weeks
Repeatability Twice	Recommended semester of study 3
Maximal number of students 25	

Additional notes and regulations: - Teaching capacity provided by: Med-VK: 10h lecture; Med-KT: 32h lecture, 10h seminar; Med.-K: 42h lecture, 4h seminar

Georg-August-Universität Göttingen		6 ECTS
Module M.CVS.004: Modern topics in CVS and clinical research		5 SWS
Learning outcomes This course integrates the training and attendance of the presentations of recent publications in the cardiovascular field. Students who successfully finished this module have learnt to present and critically discuss scientific topics. In addition, the students will learn to design follow-up research projects to the presented topics.		Total hours Contact hours 70 h Self-study 110 h
Course (Seminar) <ul style="list-style-type: none"> • Attendance of scientific presentations • Active presentation of recent publications of the field • Design of a potential research project 		5 SWS
Examination Portfolio (contains summaries of the presented research topics with a maximum of 1 page per topic).		
Entry requirement None	Recommended pre-requisites None	
Language English	Module coordinator Dr. Christina Würtz	
Frequency Each semester	Duration 3 Semester	
Repeatability Twice	Recommended semester of study 1-3	
Maximal number of students 25		

Additional notes and regulations: -- Teaching capacity provided by: Med-VK: -; Med-KT: 70h seminar; Med.-K: -
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Part 2

Practical modules

Synopsis

The Master program **Cardiovascular Science** contains three practical modules (M.CVS.001; M.CVS.002, M.CVS.003) each with a duration of 8 weeks and a final module in which the master thesis is performed over a period of 6 month.

M.CVS.101: Cardiovascular Basics I

M.CVS.001: Lab rotation I

M.CVS.102: Cardiovascular Basics II

M.CVS.002: Lab rotation II

M.CVS.201: Cardiovascular diseases and therapies

M.CVS.301: Cardiovascular research in academia and industry

M.CVS.003: Lab rotation III

M.CVS.004: Modern topics in CVS and clinical research

Master Thesis

Georg-August-Universität Göttingen Module M.CVS.001: Lab rotation I	12 ECTS 18 SWS
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Learning outcomes The practical work will be performed in a group with an expertise in cardiovascular research under direct one-to-one supervision. By working in a research project the students will learn 1.) Answering scientific questions with state-of-the-art techniques 2.) Analyzing the obtained data critically 3.) Managing time and resources in a scientific project 4.) Presenting and discussing the data in an appropriate scientific written form 5.) Presenting the data in an oral presentation.	Total hours Contact hours 252 h Self-study 108 h
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Course 1. Lab rotation I (Practical course, 238h)	17 SWS
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Examination Scoring of the personal performance, clarity and completeness of the lab book and the lab report (max. 20 pages). Lab report should be build up like a scientific publication containing Introduction, Materials & Methods, Results and Discussion.	
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Course Lab rotation experience I (Seminar, 14h)	1 SWS
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Examination Oral presentation (30 min): PowerPoint presentation about the own lab rotation containing: short information about the institution, topic of the lab rotation, short scientific background, used methods and concluding data discussion.	
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Entry requirement None	Recommended pre-requisites None
Language English	Module coordinator Prof. Ralf Dressel
Frequency Each semester	Duration 8 weeks
Repeatability Once	Recommended semester of study 1
Maximal number of students 1	

Additional notes and regulations: The evaluation of the lab rotation must be handed in via email to the coordination office latest 16 weeks after start of the rotation.

Georg-August-Universität Göttingen Module M.CVS.002: Lab rotation II	12 ECTS 18 SWS
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Learning outcomes The practical work will be performed in a group with an expertise in cardiovascular research under direct one-to-one supervision. By working in a research project the students will learn 1.) Answering scientific questions with state-of-the-art techniques 2.) Analyzing the obtained data critically 3.) Managing time and resources in a scientific project 4.) Presenting and discussing the data in an appropriate scientific written form 5.) Presenting the data in an oral presentation.	Total hours Contact hours 252 h Self-study 108 h
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Course 1. Lab rotation II (Practical course, 238h)	17 SWS
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Examination Scoring of the personal performance, clarity and completeness of the lab book and the lab report (max. 20 pages). Lab report should be build up like a scientific publication containing Introduction, Materials & Methods, Results and Discussion.	
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Course Lab rotation experience II (Seminar, 14h)	1 SWS
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Examination Oral presentation (30 min): PowerPoint presentation about the own lab rotation containing: short information about the institution, topic of the lab rotation, short scientific background, used methods and concluding data discussion.	
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Entry requirement Passed practical module M.CVS.001	Recommended pre-requisites None
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Language English	Module coordinator Prof. Ralf Dressel
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Frequency Each semester	Duration 8 weeks
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Repeatability Once	Recommended semester of study 2
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Maximal number of students 1	
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Additional notes and regulations: The evaluation of the lab rotation must be handed in via email to the coordination office latest 16 weeks after start of the rotation.

Georg-August-Universität Göttingen Module M.CVS.003: Lab rotation III	11 ECTS 17 SWS
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Learning outcomes The practical work will be performed in a group with an expertise in cardiovascular research under direct one-to-one supervision. By working in a research project the students will learn 1.) Answering scientific questions with state-of-the-art techniques 2.) Analyzing the obtained data critically 3.) Managing time and resources in a scientific project 4.) Presenting and discussing the data in an appropriate scientific written form	Total hours Contact hours 238 h Self-study 92 h
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Course 1. Lab rotation II (Practical course, 238h)	17 SWS
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Examination Scoring of the personal performance, clarity and completeness of the lab book and the lab report (max. 20 pages). Lab report should be build up like a scientific publication containing Introduction, Materials & Methods, Results and Discussion.	
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Entry requirement Passed practical modules M.CVS.001 & M.CVS.002	Recommended pre-requisites Passed theoretical module M.CVS.101 & M.CVS.102
Language English	Module coordinator Prof. Ralf Dressel
Frequency Each semester	Duration 8 weeks
Repeatability Once	Recommended semester of study 3
Maximal number of students 1	

Additional notes and regulations: The evaluation of the lab rotation must be handed in via email to the coordination office latest 16 weeks after start of the rotation.

Georg-August-Universität Göttingen		30 ECTS
Master thesis		
Learning outcomes The practical work will be performed in a group with an expertise in cardiovascular research under direct one-to-one supervision. By working in a research project the students will learn 1.) Answering scientific questions with state-of-the-art techniques 2.) Analyzing the obtained data critically 3.) Managing time and resources in a scientific project 4.) Presenting and discussing the data in an appropriate scientific written form 5.) Presenting the data in an oral presentation.		
Course Master thesis		
Examination The Master thesis will be judged by two reviewers according to common scientific standards and rules		30 ECTS
Entry requirement 67ECTS Passed theoretical modules M.CVS.101, M.CVS.102; M.CVS.201, M.CVS.301 Passed practical modules M.CVS.001, M.CVS.002	Recommended pre-requisites 90 ECTS	
Language English	Module coordinator None	
Frequency Every time	Duration 6 months	
Repeatability Once	Recommended semester of study 4	
Maximal number of students		

Part 3

Elective modules

Synopsis

In the Master program **Cardiovascular Science**, students must also complete a total of 13C from elective modules. These 13C can be chosen independently and without specifications from the entire catalogue of the university or university medicine, and credits from other universities can also be credited. The program itself also offers elective modules

M.CVS.901: Biobanking - Grundlagen für Theorien und Praxis

M.CVS.902: Biobanking - Biospecimen Research Methods

M.CVS.903: Ausschussarbeit in der studentischen oder akademischen Selbstverwaltung

M.CVS.904: In vivo imaging and microCT in mouse disease models

M.CVS.905: Meet the industry

M.CVS.906: Basics of Research Design and Statistics

M.CVS.907: Introduction to NCBI

Georg-August-University Göttingen Module M.CVS.901: Biobanking – Grundlagen für Theorien und Praxis	2 ECTS
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Lernziele/Kompetenzen: Nach Abschluss des Moduls kennen die Studierenden den Aufbau einer Biobank und sind vertraut mit dem Prinzip der Qualitätssicherung im Biobanking. Sie können die Abläufe zur Entnahme, Bearbeitung, Lagerung und Ausgabe von Bioproben und die Erfassung dazugehöriger Daten erklären. Sie wissen, wie präanalytische Effekte, die Analyseergebnisse beeinflussen und durch standardisierte Prozesse minimiert werden können. Sie kennen die ethischen und rechtlichen Rahmenbedingungen für die Nutzung von Bioproben und assoziierten Daten in Forschungsprojekten und können dieses Wissen auf eigene Projekte anwenden	Total hours Contact hours 10 h Self-study 50 h
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Prüfung: Written electronic exam (90 questions, 180 min) about the development, physiology and anatomy of the heart and the cardiovascular system and its hormonal and nervous regulation.	
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Zugangsvoraussetzungen Keine	Empfohlene Vorkenntnisse Keine
Sprache Deutsch	Modulverantwortliche(r) PD Dr. Sarah Nussbeck
Angebotshäufigkeit: jedes Semester	Dauer: 5 Wochen
Wiederholbarkeit: zweimalig	Empfohlenes Fachsemester: -

Georg-August-University Göttingen Module M.CVS.902: Biobanking - Biospecimen Research Methods"	2 ECTS SWS
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<p>Learning outcomes <i>The program is aimed at those interested in receiving a comprehensive introduction to biobanking. The content is taught using modern learning methods such as videos, quizzes and infographics.</i></p> <p><i>Course content:</i> Module 1 – Overview of Biospecimen Research Module 2 – Biospecimen Collection and Processing Module 3 – Biospecimen Storage and Distribution Module 4 – Data Systems and Records Management Module 5 – Ethics, Privacy and Consent</p>	<p>Total hours Contact hours 20 h Self-study 40 h</p>
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<p>Examination: Written report at the end of each semester, not graded</p>	
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Entry requirement None	Recommended pre-requisites None
Language English	Module coordinator PD Dr. Sarah Nussbeck
Frequency Each semester	Duration 10 weeks
Repeatability twice	Recommended semester of study 1

Georg-August-Universität Göttingen Modul M.MM.903: Ausschussarbeit in der studentischen oder akademischen Selbstverwaltung		2 C SWS
Lernziele/Kompetenzen: Die Studierenden erwerben zentrale Kenntnisse über die Organisationsstrukturen und Entscheidungsprozesse in der akademischen Selbstverwaltung einer Fakultät. Sie erwerben die Fähigkeit, in universitären Gremien mitzuwirken, studentische Anliegen zu vertreten und die Prozesse in diesen Gremien kritisch zu reflektieren. Die Studierenden entwickeln Kompetenzen in den Bereichen Rhetorik, Dialog und Diskurs sowie Gesprächsführung, Argumentation und Konfliktlösung. Sie erhalten vertiefte Einblicke in die Struktur, die Prozesse und die Funktionsweise einer Fakultät oder anderer Organisationseinheiten einer Hochschule in den Bereichen Studium und Lehre, Forschung und Verwaltung.		Arbeitsaufwand: Präsenzzeit: 20 Stunden Selbststudium: 40 Stunden
Prüfung: Bericht zum Ende jedes Semesters; unbenotet		
Zugangsvoraussetzungen: Nachweis der Tätigkeit und Mitgliedschaft in einem Gremium der Medizinischen Fakultät oder einem anderen Gremium der Georg-August-Universität; Tätigkeit als studentische/r Vertreter/in des Masterstudiengangs „Cardiovascular Science“.	Empfohlene Vorkenntnisse: keine	
Sprache: Deutsch	Modulverantwortliche[r]: Prof. Dr. rer. nat. Susanne Lutz	
Angebotshäufigkeit: jedes Wintersemester	Dauer: 4 Semester	
Wiederholbarkeit: -	Empfohlenes Fachsemester: -	

Georg-August-University Göttingen Module M.CVS.904: In vivo imaging and microCT in mouse disease models	1 ECTS SWS
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Learning outcomes The hands-on session is meant to deepen the understanding of the core principles and limitations of CT and optical imaging by performing simple experiments and data analysis. Under supervision you will have the opportunity to operate the imaging device on your own.	Total hours Contact hours 10 h Self-study 20 h
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Examination: Written protocol after completion of the course; graded	
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Entry requirement Participation in the lectures. No pregnancy.	Recommended pre-requisites None
Language English	Module coordinator Dr. Christian Dullin
Frequency Each summer semester	Duration 1 week
Repeatability twice	Recommended semester of study 1

Georg-August-University Göttingen Module M.CVS.905: Meet the industry	1 ECTS SWS
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Learning outcomes Students acquire central knowledge of the organizational structures and decision-making processes in the academic self-administration of a faculty. They acquire the ability to participate in university committees, to represent student concerns and to critically reflect on the processes in these committees. Students develop skills in the areas of rhetoric, dialogue and discourse, as well as conversation, argumentation and conflict resolution. They gain in-depth insights into the structure, processes and function of a faculty or other organizational units of a university in the areas of study and teaching, research and administration.	Total hours Contact hours 15 h Self-study 30 h
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Examination: Regular participation in the lectures, as well as submission of a letter of application for an advertised position in the industry, including a suitable cover letter and an elaborated CV. Not graded.	
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Entry requirement None	Recommended pre-requisites None
Language English	Module coordinator Dr. Christina Würtz
Frequency Each winter semester	Duration 1 semester
Repeatability twice	Recommended semester of study 3