Georg-August-Universität
Göttingen

Directory of Modules

Master-Studiengang "Cardiovascular Science" - referring to: Prüfungs- und Studienordnung für den konsekutiven Master-Studiengang "Cardiovascular Science" (Amtliche Mitteilungen I 20/2015 p. 353, zuletzt geändert durch Amtliche Mitteilungen I 21/2024 p. 368)

Modules

Index by areas of study

I. Master's degree programme "Cardiovascular Science"

To successfully complete the Master's degree programme, a total of 120 C must be earned by the following regulations.

1. Specialised Studies

The following eight modules comprising 77 C have to be passed:

2. Professionalisation

Licit modules comprising at least 13 C must be passed. Students may take modules listed in the Göttingen University's Module Handbook of Key Competencies, whereof a maximum of 9 C can be chosen from the course offerings by the Centre for Languages and Key Competencies (ZESS) in accordance with the "Prüfungsordnung für Studienangebote der Zentralen Einrichtung für Sprachen und Schlüsselkompetenzen (ZESS) der Georg-August-Uninversität Göttingen" in its currently valid version.

3. Master's thesis

A total of 30 C are awarded for passing the Master's thesis.

Georg-August-Universität Göttingen **Module M.CVS.001: Lab rotation I**	12 C 18 WLH

Learning outcome, core skills: 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	**Workload:** Attendance time: 252 h Self-study time: 108 h

Course: Lab rotation I (Lab rotation)	17 WLH
Examination: Lab report (max. 20 pages) **Examination requirements:** Scoring of the personal performance, clarity and completeness of the lab book and the lab report. Lab report should be build up like a scientific publication containing Introduction, Materials & Methods, Results and Discussion.	10 C

Course: Lab rotation experience I (Seminar)	1 WLH
Examination: Oral Presentation (approx. 30 minutes) **Examination requirements:** Oral presentation: 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.	2 C

Admission requirements: None	**Recommended previous knowledge:** None
Language: English	**Person responsible for module:** Prof. Dr. Ralf Dressel
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1
Maximum number of students: 25	

Additional notes and regulations:
The grade and 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 C 18 WLH

Learning outcome, core skills: 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.	**Workload:** Attendance time: 252 h Self-study time: 108 h

Course: Lab rotation II (Lab rotation)	17 WLH
Examination: Minutes / Lab reportLab report (max. 20 pages) **Examination requirements:** Scoring of the personal performance, clarity and completeness of the lab book and the lab report. Lab report should be build up like a scientific publication containing Introduction, Materials & Methods, Results and Discussion.	10 C

Course: Lab rotation experience II (Seminar)	1 WLH
Examination: Oral Presentation (approx. 30 minutes) **Examination requirements:** Oral presentation: 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.	2 C

Admission requirements: None	**Recommended previous knowledge:** None
Language: English	**Person responsible for module:** Prof. Dr. Ralf Dressel
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2
Maximum number of students: 25	

Additional notes and regulations:
Lab rotation M.CVS.002 should be done in another lab than Lab rotation M.CVS.001.
Both rotations should differ in the used methods.

The grade and 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 C 17 WLH

Learning outcome, core skills: 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	**Workload:** Attendance time: 238 h Self-study time: 92 h

Course: Lab rotation III (Lab rotation)	17 WLH
Examination: Lab report (max. 20 pages) **Examination requirements:** 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.	11 C

Admission requirements: None	**Recommended previous knowledge:** None
Language: English	**Person responsible for module:** Prof. Dr. Ralf Dressel
Course frequency: each semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3
Maximum number of students: 25	

Additional notes and regulations:
Students can chose a topic for their “Lab rotation III” out of the “List of practical courses for M.Sc. Cardiovascular Science”
Lab rotation III has to be done in another lab than Lab rotation I and II.
All rotations should differ in the used methods.

Georg-August-Universität Göttingen **Module M.CVS.004: Modern topics in CVS and clinical research**	6 C 5 WLH

Learning outcome, core skills: Students who have successfully completed this module have heard several scientific presentations from the field of cardiovascular research. They are able to summarise these. They have learnt to present and critically discuss scientific topics themselves. In addition, students learn to design further research projects on the topics presented.	**Workload:** Attendance time: 70 h Self-study time: 110 h

Course: Modern topics in CVS and clinical research (Seminar) *Contents*: Attendance of min. 3 scientific presentations	5 WLH
Examination: Portfolio (max. 20 pages) **Examination requirements:** The portfolio to be submitted is designed to accompany students throughout their studies. The portfolio should give you the opportunity to think about and reflect on your professional expectations, your learning progress, the way you make decisions and much more. In addition, the portfolio includes the summary of three academic presentations.	6 C

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. Christina Würtz
Course frequency: each semester	**Duration:** 3 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1 - 3
Maximum number of students: 25	

Georg-August-Universität Göttingen **Module M.CVS.101: Cardiovascular basics I**	9 C 7 WLH

Learning outcome, core skills: Students who have successfully completed this module have advanced knowledge of: 1.) The anatomy of the heart, blood vessels, lungs, kidneys, nervous system of humans nervous system of humans, rodents and widely used laboratory animals (e.g. zebrafish) 2.) Embryonic development in general and the cardiovascular system 3.) The physiology of the heart, the circulatory system, the lungs, the kidneys, the autonomic nervous system, including, for example, detailed knowledge of the control of cardiac contractility and function, short- and long-term control of blood pressure, important haemodynamic principles 4.) The hormonal control of the cardiovascular system, e.g. by catecholamines, the RAAS, natriuretic peptides, sex hormones	**Workload:** Attendance time: 98 h Self-study time: 172 h

Course: Cardiovascular basics I (Lecture) *Contents*: 1. cardiovascular basics I (lectures, 70 h) Contents • Cardiovascular anatomy • Cardiovascular embryology • Cardiovascular physiology • Cardiovascular nervous system • Cardiovascular endocrinology 2. cardiovascular basics I (practical course, 28h) Contents • Cardiovascular anatomy • Histology course of cardiovascular tissues • Cardiovascular physiology	5 WLH
Examination: Written examination (120 minutes) **Examination requirements:** Written exam (180 min) about the development, physiology and anatomy of the heart and the cardiovascular system and its hormonal and nervous regulation.	7 C

Course: Cardiovascular basics I (Practical course) *Contents*: • Cardiovascular anatomy • Histology of the cardiovascular tissue • Cardiovascular Physiology	2 WLH
Examination: Oral Presentation (approx. 15 minutes), not graded **Examination requirements:** Presentation of current publications from the cardiovascular field. Seminar presentation (oral, 15 min): Short PowerPoint presentation on a given topic, with max. 5 minutes discussion	2 C

Admission requirements: None	**Recommended previous knowledge:** None
Language: English	**Person responsible for module:** Prof. Dr. Laura Zelarayan-Behrend
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1
Maximum 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:-

Georg-August-Universität Göttingen **Module M.CVS.102: Cardiovascular basics II**	9 C 7 WLH

Learning outcome, core skills: Students who have successfully finished this module have an advanced knowledge of: 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 8.) 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.	**Workload:** Attendance time: 98 h Self-study time: 172 h

Course: Cardiovascular basics II (Lecture) *Contents*: • Cardiovascular cell biology • Cardiovascular biophysics • Cardiovascular biochemistry • Cardiovascular (epi)genetic • Cardiovascular signal transduction	5 WLH
Examination: Written examination (120 minutes) **Examination requirements:** Written exam (180 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	7 C

Course: Cardiovascular basics II (Seminar) *Contents*: Presentation of current publications from the cardiovascular field. Seminar presentation (oral, 15 min): Short PowerPoint presentation on a given topic, with max. 5 minutes discussion	2 WLH
Examination: Oral Presentation (approx. 15 minutes) **Examination requirements:** Seminar presentation (oral, approx. 15 min.): Short PowerPoint presentation about a given topic, including approx. 5 minutes discussion	2 C

Admission requirements:	**Recommended previous knowledge:**

None	Passed examination in module M.CVS.101
Language: English	**Person responsible for module:** PD Ph.D. Xingbo Xu
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 1
Maximum number of students: 25	

Additional notes and regulations:

Teaching capacity provided by:

Med-VK: 20h lecture, 4h seminar; Med-KT: 30h lecture, 6h seminar; Med.-K: 34h, 4h seminar

Georg-August-Universität Göttingen **Module M.CVS.201: Cardiovascular diseases and therapies**	9 C 7 WLH

Learning outcome, core skills: Students who have successfully finished this module have an advanced knowledge of: 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	**Workload:** Attendance time: 98 h Self-study time: 172 h

Course: Cardiovascular diseases and therapies (Lecture) *Contents*: • Clinical and molecular aspects of cardiovascular diseases in adults and children • Cardiovascular imaging • Interventional therapies • Cardiovascular surgery • Cardiovascular pharmacology	5 WLH
Examination: Written examination (120 minutes) **Examination requirements:** 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	7 C

Course: Cardiovascular diseases and therapies (Practical course) *Contents*: 2. cardiovascular diseases and their therapies (practical course, 14h) Course content • ECG reading • Case studies	2 WLH
Examination: Oral Presentation (approx. 15 minutes), not graded	2 C

Examination requirements: Presentation of current publications from the cardiovascular field. Lecture (oral, 15 min): Short PowerPoint presentation on a given topic, with max. 5 minutes discussion	

Admission requirements: None	**Recommended previous knowledge:** Passed examination in module M.CVS.101 and M.CVS.102
Language: English	**Person responsible for module:** Prof. Dr. rer. nat. Susanne Lutz
Course frequency: each summer semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 2
Maximum number of students: 25	

Additional notes and regulations:

Teaching capacity provided by:

Med-VK: -; Med-KT: 28h lecture; Med.-K: 56h lecture, 14h practical work

Georg-August-Universität Göttingen **Module M.CVS.301: Cardiovascular research in academia and industry**	9 C 7 WLH

Learning outcome, core skills: 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 including e.g. animal models, imaging techniques, high throughput technologies, stem cell-based research, tissue engineering, system biology; 3. Biostatistics; 4. Research standards in industry; 5. The design and management of clinical trials.	**Workload:** Attendance time: 98 h Self-study time: 172 h

Course: Cardiovascular research in academia and industry (Lecture) *Contents*: • Scientific Aspects of cardiovascular diseases • State-of-the art research methods • Biostatistics • Design and management of clinical trials • Insights in research in industry	5 WLH
Examination: Written examination (120 minutes) **Examination requirements:** 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	7 C

Course: Cardiovascular research in academia and industry (Seminar) *Contents*: Presentation of recent publications from the cardiovascular field.	2 WLH
Examination: Oral Presentation (approx. 15 minutes) **Examination requirements:** Seminar presentation (oral, approx. 15 min.): Short PowerPoint presentation about a given topic, including approx. 5 minutes discussion	2 C

Admission requirements: None	**Recommended previous knowledge:** Passed examinations in modules M.CVS.101, M.CVS.102 and M.CVS.201
Language: English	**Person responsible for module:** Dr. Tim Meyer
Course frequency: each winter semester	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:** 3

Maximum 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 **Module M.CVS.901: Biobanking - Biospecimen Research Methods**	2 C 2 WLH

Learning outcome, core skills: After completing the module, students will be familiar with the structure of a biobank and the principle of quality assurance in biobanking. They will be able to explain the procedures for taking, processing, storing and issuing biosamples and recording the associated data. They know how pre-analytical effects influence the analysis results and can be minimised through standardised processes. They know the ethical and legal framework for the use of biosamples and associated data in research projects and can apply this knowledge to their own projects.	**Workload:** Attendance time: 4 h Self-study time: 56 h

Course: Biobanking - Grundlagen für Theorien und Praxis () *Contents*: 1) Overview of research with biosamples 2) Collection and processing of biosamples 3) Storage and provision of biosamples 4) Data systems and documentation management 5) Ethics, data protection and informed consent	
Examination: Written examination (4) **Examination prerequisites:** Successful completion of all 5 sub-modules	2 C

Examination requirements: Module quiz and final exam	

Admission requirements: none	**Recommended previous knowledge:** none
Language: German	**Person responsible for module:** PD Dr. rer. nat. Sara Yasemin Nußbeck
Course frequency: winter or summer semester, on demand	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.CVS.902: Biobanking - Biospecimen Research Methods**	2 C 2 WLH

Learning outcome, core skills: After completing the module, students will be familiar with the structure of a biobank and the principle of quality assurance in biobanking. They will be able to explain the procedures for taking, processing, storing and issuing biosamples and recording the associated data. They know how pre-analytical effects influence the analysis results and can be minimised through standardised processes. They know the ethical and legal framework for the use of biosamples and associated data in research projects and can apply this knowledge to their own projects.	**Workload:** Attendance time: 4 h Self-study time: 56 h

Course: Biobanking - Biospecimen Research Methods *Contents*: Module 1 - Overview of research with biosamples Module 2 - Collection and processing of biosamples Module 3 - Storage and provision of biosamples Module 4 - Data systems and documentation management Module 5 - Ethics, data protection and informed consent *Course frequency:* each winter semester	
Examination: Written examination	2 C

Examination requirements: Module quiz and final exam	

Admission requirements: None	**Recommended previous knowledge:** None
Language: English	**Person responsible for module:** PD Dr. rer. nat. Sara Yasemin Nußbeck -
Course frequency: winter or summer semester, on demand1	**Duration:** 1 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations: -

Georg-August-Universität Göttingen **Module M.CVS.903: Committee work in student or academic self-administration**	2 C 2 WLH

Learning outcome, core skills: Students acquire key knowledge of the organisational structures and decision-making processes in the academic self-administration of a faculty. They acquire the ability to participate in university committees, represent student concerns and critically reflect on the processes in these committees. Students develop skills in the areas of rhetoric, dialogue and discourse as well as conducting discussions, argumentation and conflict resolution. They gain in-depth insights into the structure, processes and functioning of a faculty or other organisational units of a university in the areas of study and teaching, research and administration.	**Workload:** Attendance time: 28 h Self-study time: 32 h

Course: M.CVS.903 - Committee work in student or academic self-administration (Key competence)	
Examination: Report at the end of each semester; ungraded	2 C

Admission requirements: Proof of activity and membership in a committee of the Faculty of Medicine or another committee of the Georg-August University; activity as a student representative of the Master's programme ‘Cardiovascular Science’.	**Recommended previous knowledge:** -
Language: German	**Person responsible for module:** Dr. rer. nat. martina vockerodt Prof. Dr. Susanne Lutz
Course frequency: each winter semester1	**Duration:** 4 semester[s]
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Additional notes and regulations:
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Georg-August-Universität Göttingen **Module M.CVS.904: In vivo imaging and microCT in mouse disease models**	2 C 2 WLH

Learning outcome, core skills: - basic physical principles of major imaging technologies used in clinical routine and preclinical research (CT, MRI, NIRF, BLI, PET, SPECT) - image contents in those image modalities - applicability of the different methods to different research questions - specific applications for heart and lung research - challenges in the application of those techniques in small animal models - basics of image processing and data analysis with machine learning - Hands-On session using microCT and optical imaging	**Workload:** Attendance time: 28 h Self-study time: 32 h

Course: M.CVS.904 - In vivo imaging and microCT in mouse disease models (Internship) *Contents*: 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 the students will have the opportunity to operate the imaging device on their own.	
Examination: Minutes / Lab report **Examination prerequisites:** Participation in the lectures within M.CVS.102 and participation in the praktical part of M.CVS.904. **Examination requirements:** Written examination and protocol	1 C

Examination requirements: - electronic examination - protocol for the hands-on session	

Admission requirements: Participation in the lectures within M.CVS.102 No pregnancy	**Recommended previous knowledge:** None
Language: English	**Person responsible for module:** apl. Prof. Christian Dullin
Course frequency: each winter semester1	**Duration:**
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students:	

not limited	

Georg-August-Universität Göttingen **Module M.CVS.905: Meet the industry**	1 C 1 WLH

Learning outcome, core skills: In this module, students gain insights into possible future fields of work, primarily in industry, but also in positions within the academy. Former students of the B.Sc./M.Sc./ PhD Molecular Medicine and M.Sc./PhD Cardiovascular Science programmes will talk about their experiences and their individual career paths. Information is shared on topics such as application processes, everyday working life, work-life balance and pay.	**Workload:** Attendance time: 14 h Self-study time: 16 h

Course: Discussion rounds *Contents*: Discussion rounds with former students.	

Examination requirements: Regular participation in the discussion rounds with the invited guests.	

Admission requirements: none	**Recommended previous knowledge:** none
Language: English	**Person responsible for module:** Dr. rer. nat. martina vockerodt
Course frequency: each winter semester1	**Duration:**
Number of repeat examinations permitted: twice	**Recommended semester:**
Maximum number of students: not limited	

Georg-August-Universität Göttingen **Module M.CVS.906: Single-cell data analysis hands-on procedures**	0,5 C 1 WLH

Learning outcome, core skills:	**Workload:**
• Understanding the basic concepts/pipeline of single-cell data analysis • Mastering the pre-processing and quality control of single-cell datasets • Perform clustering and dimensionality reduction techniques • Identify and interpret differentially expressed genes • Visualisation of single-cell data with various tools • Performing cell annotation and classification • Performing Gene Ontology (GO) enrichment analyses • Performing KEGG pathway analyses for functional insights • Application of trajectory analysis to derive cell differentiation pathways	Attendance time: 8 h Self-study time: 7 h

Course: Single-cell data analysis hands-on procedures	
Examination: Presentation **Examination requirements:** • A practical task based on a given data set • A short presentation summarising the results of the analysis	

Admission requirements: Participation in the lecture as part of the module M.CVS.102	**Recommended previous knowledge:** Lecture M.CVS.102
Language: English	**Person responsible for module:** PD Ph.D. Xingbo Xu
Course frequency: each summer semester1	**Duration:**
Number of repeat examinations permitted: twice	**Recommended semester:** from 2
Maximum number of students: not limited	