MASTER’S PROGRAM
IN
CARDIOVASCULAR TECHNOLOGY

- WITH SPECIAL REFERENCE TO CARDIOPULMONARY BYPASS

The Faculty of Health Sciences, University of Aarhus, Denmark

The Engineering College of Aarhus

Aarhus University Hospital

Recommended by the Scandinavian Society of Extra Corporeal Technology and
The European Board of Cardiovascular Perfusion
**INTRODUCTION**

This master’s program includes a core curriculum of mandatory cardiovascular courses and a broad range of elective courses within the cardiovascular and biomedical engineering field, including perfusion techniques. A student who wishes to work within the health sector will obtain the necessary background to manage extracorporeal circulation with a heart-lung machine during cardiac surgery and take part in introducing new cardiovascular monitoring and treatment techniques that demand special qualifications. In addition, the program will give the student experience in research relating to the development and use of new cardiovascular technologies.

The master’s program is offered by the Faculty of Health Sciences, University of Aarhus in collaboration with the Engineering College of Aarhus and Aarhus University Hospital, Skejby, which all perform quality teaching on an international level.

**AIM**
- To ensure the necessary qualifications to mind and manage extracorporeal circulation and circulatory support units used during and after cardiac surgery.
- To ensure the scientific skills that are necessary to participate in clinical research within the cardiovascular area.

**ENTRY REQUIREMENTS**
A relevant Bachelor’s degree in nursing, engineering, medicine, chemistry, biology, physics, laboratory biotechnology or a similar background, e.g. senior nurse, is required to begin this program. Additionally, at least 2 years of relevant clinical or technical experience after completion of such education is required. Such experience could be from a surgery department, intensive care unit, department of anaesthesiology, or a biomedical engineering department in a hospital or industry.

**DURATION**
The program is based on part-time tuition over 4 semesters, with duration of 2 years. There are 4 modules, where one module each semester consists of full-time tuition covering the first 6 weeks, starting around September 1st and February 1st.

**LANGUAGE**
The official language will be English.

**STRUCTURE**
The first 3 modules are divided up into 3 courses. The 4th module will be used to perform the final master thesis. There is an examination/assessment shortly after each module.

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Each course represents a total of 5 ECTS points (European Credit Transfer System) and consists of approximately 50 hours of tuition and laboratory exercises.

Lectures will be given at the Faculty of Health Sciences, Aarhus University, the Engineering College and Aarhus University Hospital, Skejby. Animal experimental exercises will take place at The Clinical Institute, Aarhus University. Fluid mechanics and medical instrumentation demonstrations and exercises will take place at the laboratories of Aarhus University Hospital, Skejby and the new Cardiovascular Fluid Dynamics Lab at the Engineering College of Aarhus.

**TITLE AND COMPETENCE PROFILE**
Completion of the program leads to the title: Master of Cardiovascular Technology.

A master’s degree in cardiovascular technology with speciality in perfusion techniques will, complemented with clinical practice approved by The National Health Board and The European Board of Cardiovascular Perfusion (EBCP), qualify the student to perform the following tasks:

- set up and manage extracorporeal circulation using a heart-lung machine during open heart surgery
- set up and manage circulatory support, including use of an inter aortic balloon pump, ventricle assist systems or an artificial heart
- set up and manage extracorporeal membrane oxygenation
- set up and manage extracorporeal circulation in non-cardiovascular applications, such as selective organ perfusion
- supervise surgical procedures concerning treatment of heart rhythm disorders, including pacemaker implantation
- participate in an interdisciplinary collaboration involving research and development of new methods for surveillance, diagnostics and treatment of cardiovascular patients
- collaborate with the biomedical industry concerning exploitation of research results for development of new equipment with the cardiovascular field
- assess new methods and equipment in the cardiovascular field
- teach the theoretical background for and application of new cardiovascular methods

**ADVISORY COMMITTEE**
In addition to the academic committee required for master programs in Denmark, an advisory committee will be established, representing employers of the graduated masters from hospitals and industries in Scandinavia, as well as member from EBCP and SCANSECT.

**REGULATIONS**
The master’s program is based on regulations concerning master programs from The Ministry of Science, Technology and Innovation (no. 682, August 16, 2002), and The National Board of Health’s regulations concerning perfusion education (no. 68, May 17, 1995).

**TUITION FEE**
€ 14.000,00 includes books and teaching material for all four semesters but not room and board.
CIRCULATORY PHYSIOLOGY
Anatomy and physiology
Cardiac physiology
Circulation physiology
Pathophysiology
Blood-gas and acid-base physiology
Haematology
Circulatory biophysics
Prenatal physiology
Myocardial protection
Hemodynamics
Pressure and flow regulation
Laboratory exercises

CARDIOVASCULAR SURGERY
Heart valve disease
Coronary artery disease
Valve surgery
Coronary surgery
Vascular surgery
Lung surgery
Anaesthesia
Pharmacology and the circulation
Cardioplegia
Intensive care
Organ transplantation
Extracorporeal circulation
Circulatory support
Interventional cardiology
Post-operative care

MEDICAL INSTRUMENTATION
Applied mathematics
Basic electronics
Fluid dynamics
Measuring techniques
Static and dynamic characteristics
Transducers and chemical biosensors
Amplifiers and signal processing
Hemodynamics
Measurement of blood pressure
Heart sounds and murmurs
Measurement of blood flow
Catheterization
Patient safety
Laboratory exercises

BIOCHEMISTRY AND MICROBIOLOGY
Clinical chemistry and biochemistry
Microbiology and bacteriology
Hygiene
Sterilisation techniques
The immune system
The complement system
Inflammatory response
The endocrine system
The coagulation system
Anti coagulant therapy

ELECTROPHYSIOLOGY AND MEDICAL IMAGING TECHNIQUES
The origin of bio potentials
The electrical functions of the heart
Electrodes
Electrocardiography
Pacemaker treatment
Arrhythmia
Arrhythmia treatment
X-ray imaging techniques
Radionuclide imaging
MR-imaging
Ultrasound imaging
Doppler ultrasound
Echocardiography
Laboratory exercises

RESEARCH IN MEDICAL SCIENCE
Theory of science
Research methodology
Ethics
Planning of experiments
Biostatistics
Search for literature
Abstracts and posters
Publication techniques
Oral presentation
Law and medicine
Exercises

PERFUSION TECHNIQUES 1
The history of perfusion
The heart-lung machine
Oxygenerators
Blood pumps
Open and closed circuits
Reservoirs and filters
Cannulation and drainage
Cardioplegia
Safety in perfusion
Pressure and flow
Problems and accidents
Evaluation and storage of data
Vent and suction
Use of the heater / cooler, temperature regulation
 Priming solution and hemodilution
Cardiovascular products
Laboratory exercises

PERFUSION TECHNIQUES 2
Hypothermia
pH/alfa stat
VAVD – Vacuum Assisted Venous Drainage
Hemodynamics and ECC
Embolies – solid and air
Blood- air and surface interface
Bubble detection and bubble trap
Cavitation / HITS / MES
In-line monitoring
Cell-savers, hemofiltration and other blood saving techniques

FURTHER INFORMATION:
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