



ADMISSION REQUIREMENTS

• AOS CARDIOVASCULAR TECHNOLOGIST PROGRAM

1. All applicants for the AOS degree programs will be ranked using a point system in specific categories. Refer to the Admission Point System form.
2. A letter grade of B, or a minimum GPA of 3.0 is required for all General Education courses in the AOS programs.
3. A high school diploma or its equivalent.
4. Documentation of high school transcript or GED certificate.
5. Documentation of college credits and advanced degree(s) if applicable.
6. Proficiency in keyboarding is preferred.
7. Prior allied health work experience is preferred.
8. A personal interview at the school between applicant and Admissions Officer.
9. A pre-enrollment interview with the Director of Education.
10. Completion of entrance examination.
11. Three (3) Professional references.
12. Resume (one page).
13. Submission of a formal application as provided by the school. Arrangements for high school or college transcripts will be made prior to enrollment.
14. The above factors will determine the applicant's ranking in the point system.

PROGRAM: CARDIOVASCULAR TECHNOLOGIST

Program Description:

The AOS Cardiovascular Technologist students are trained in the performance of non-invasive diagnostic cardiac ultrasound, which provides digital and video image acquisition of normal and abnormal anatomic and physiologic data.

Training in cardiovascular diagnostics emphasizes basic and advanced electrocardiology, electrocardiography, echocardiography, and cardiac Doppler. Color flow and harmonics ultrasound equipment is provided for extensive echocardiography hands-on practice. Class size is limited to assure close supervision during classroom training and practical application of the various procedures.

The core curriculum includes the study of human anatomy and physiology, cardiovascular pharmacology, vital signs, cardiopulmonary resuscitation, IV administration, ultrasound physics, and an introduction to medical electronics and instrumentation. This provides an understanding of diagnostic procedures in ECG, Holter Monitoring, Exercise Stress Testing, Telemetry, Echocardiography and Cardiac Doppler, enabling students to demonstrate accurate performance of these examinations.



The externship rotation is an integral part of the training program. Eligible students are assigned to school-approved hospital site or medical facility and will maintain this rotation until all required hours have been successfully completed within the duration of eligibility. Refer to Student Handbook.

Due to the technical nature of this program, it is preferred that the student have prior allied health training, recent clinical work experience and college credits. Class size is limited to assure close supervision during classroom and externship training.

Upon successful completion of the AOS Cardiovascular Technologist Program, and the knowledge and skills acquired, students are prepared for responsible career entry positions with advancement opportunities in hospitals, specialty clinics, doctor's offices, and non-invasive cardiovascular laboratories. The minimum expectation is to prepare competent entry-level Cardiovascular Technologists in the cognitive (knowledge), psychomotor (skills) and affective (behavior) learning domains for adult echocardiography. There is a widespread demand for competent, credentialed Cardiovascular Technologists.

Marketable Skills / Outcomes:

Upon completion of program requirements, Carnegie Cardiovascular Technologist graduates will be able to:

- Utilize, communication, critical thinking and mathematic skills in assessment, planning, intervention, and evaluation of patient care.
- Demonstrate understanding of cardiac, vascular, respiratory, and renal anatomy, physiology and pathology
- Demonstrate thorough understanding of ECG and related medical terminology
- Prepare patient for electrocardiogram
- Perform electrocardiogram
- Standardize and operate various types of electrocardiograph instruments
- Recognize and correct various types of artifact
- Perform time/voltage measurements on the ECG
- Demonstrate understanding of waveform morphology
- Recognize ECG wave patterns and significance
- Recognize and interpret normal vs. abnormal wave patterns on the ECG with emphasis on lethal arrhythmias
- Recognize and interpret arrhythmias and heart block abnormalities
- Assist in the performance of exercise stress testing
- Demonstrate understanding of the indications for pacemakers, mechanisms, normal function, signs of malfunction, and ECG patterns
- Recognize electrocardiographic changes which occur in chamber enlargement and myocardial ischemia/infarction
- Perform intravenous administration, blood pressure and vital sign measurements



- Demonstrate understanding of the principles related to basic and ultrasound physics
- Demonstrate understanding of pharmacology and pharmacokinetics related to cardiac and vascular function
- Demonstrate knowledge of cardiopulmonary resuscitation through American Heart Association Healthcare Provider course
- Demonstrate basic understanding of common forms of invasive cardiac diagnostics
- Demonstrate basic understanding of cardiac hemodynamics
- Perform an echocardiogram
- Identify and measure cardiac structures on M-Mode and 2-D echocardiograms
- Evaluate systolic and diastolic left ventricular function
- Recognize most common valvular diseases, cardiomyopathies, cardiac masses, diseases of aorta, and pericardial diseases on the echocardiogram
- Demonstrate understanding of cardiac Doppler equipment
- Perform cardiac Doppler studies
- Demonstrate understanding of color flow Doppler
- Demonstrate understanding of congenital heart disease
- Adhere to the principles of medical ethics as applied to the role of the Cardiovascular Technologist

Delivery:

Hybrid – synchronous and asynchronous

- “Distance Education Program” means a program in which all courses are delivered via distance education teaching and learning activities, without the need for any on-campus in-person classes/activities.
- “Hybrid” or “Blended” means courses or programs in which some portion of on-campus instruction is replaced by distance education teaching and learning activities.
- “Synchronous” means courses where all students are required to participate at the same time with an instructor with interaction in real time between student and instructor although in separate locations. These courses may be delivered by video conferencing, web conferencing, audio conferencing, etc.
- “Asynchronous” means courses where students are not required to participate in any distance education teaching and learning activities live/in real time with an instructor, but instead engage in lecture courses based upon teaching materials and assignments compiled and made available by an instructor.

Quarterly Schedule of Instruction:

Twenty-One (21) Months

Seven (7) 12 Week Quarters and 750 Hour Externship

Quarter I: Asynchronous

Quarters II - III:

- Tuesday & Thursday, 6 PM - 9:30 PM / 5:30PM-9PM
- Saturday, 8 AM - 3 PM



Quarter IV- V

Tuesday, Thursday, Saturday, 6PM – 9:30PM / 8AM-2PM

Quarters VI & VII:

- Monday & Wednesday, 6 PM - 9:30 PM
- Saturday, 8 AM - 2 PM

Externship: 16 hours/week

Course	Contact Hours	Quarter Credit Hours
<i>Quarter I</i>		
GE011: Anatomy & Physiology	45	4.5
GE112: Algebra I	45	4.5
GE130: Written and Oral Communication	45	4.5
<i>Work Outside of Class: 67.5 Hours</i>		
<i>Total Quarter I:</i>	135	13.5
<i>Quarter II</i>		
C100a: Anatomy & Physiology / Pathophysiology / Therapeutic Communications / HIPAA	54	3.5
C101a: Physics I - Basic Ultrasound	12	0.5
C115a: Pharmacology	18	1.0
C118a1: ECG I - Theory	36	2.5
C118a2: ECG I – Practical – Telemetry & Exercise Stress Testing	36	2.0
<i>Work Outside of Class: 39 Hours</i>		
<i>Total Quarter II:</i>	156	9.5
<i>Quarter III</i>		
C100b: Anatomy & Physiology / Pathophysiology	42	2.5
C101b: Physics II - Pulsed Ultrasound	12	0.5
C115b: Pharmacology	18	1.0
C110: Vital Signs: Theory & Practical / IV Administration: Theory & Practical	12	0.5
C128b1: ECG II - Theory	36	2.5
C128b2: ECG II - Practical - 12-Lead Analysis, Arrhythmia Interpretation	32	2.0
C129 Healthcare Provider Basic Life Support	4	0.0
<i>Work Outside of Class: 39 Hours</i>		
<i>Total Quarter III:</i>	156	9.0
<i>Quarter IV</i>		
C130a: Echocardiography I – Theory	42	2.5
C101c: Physics III - Doppler Physics	18	1.0
C130b: Echocardiography I - Practical	96	5.5
<i>Work Outside of Class: 39 Hours</i>		



Course	Contact Hours	Quarter Credit Hours
Total Quarter IV:		
	156	9.0
Quarter V		
C230a: Echocardiography II – Theory Cardiac Doppler & Pathology	42	2.5
C201a: Physics IV - Transducers	18	1.0
C230b: Echocardiography II – Practical Cardiac Doppler	96	5.5
C260a: Clinical Site Rotation / Externship	96	3.0
<i>Work Outside of Class: 39 Hours</i>		
Total Quarter V:		
	252	12.0
Quarter VI		
C240a: Echocardiography III – Theory, Cardiac Valve Pathology	42	2.5
C201b: Physics V - Instrumentation	18	1.0
C240b: Echocardiography III – Practical, Cardiac Doppler	96	5.5
C260b: Clinical Site Rotation / Externship	192	6.0
<i>Work Outside of Class: 39 Hours</i>		
Total Quarter VI:		
	348	15.5
Quarter VII		
C250a: Echocardiography IV – Theory, Cardiac Pathology	42	2.5
C201c: Physics VI - Quality Assurance & Artifacts	18	1.0
C250b: Echocardiography IV – Practical, Color Flow	96	5.5
C260c: Clinical Site Rotation / Externship	192	6.0
<i>Work Outside of Class: 39 Hours</i>		
Total Quarter VII:		
	348	15.0
Clinical Site Rotation / Externship		
C260d: Clinical Site Rotation / Externship	270	9.0
Clinical Site Rotation / Externship Total:		
	270	9.0
PROGRAM TOTAL		
	1821	92.0
<i>Work Outside of Class: 301.5 Hours</i>		
<i>Note: Total work outside of class hours are approximate.</i>		

Definitions:

- A “didactic learning environment (**theory**)” is one which is led by a qualified faculty member for the intention of teaching and learning and can be in a classroom or laboratory setting of instruction.
- A “supervised laboratory setting of instruction (**practical**)” is one where students engage in discussion and/or the practical application of information presented in the didactic portion of the program or discovered through out-of-class work/preparation.
- “Out-of-class work/preparation” is that which students engage in as a means to prepare for the didactic learning environment or supervised laboratory setting of instruction.



- “Externship” is a component of a program offered in a bona fide occupational setting for which training and education are provided, the externship component occurs during or after coursework is completed. The objectives and goals of an externship must be to allow students to apply the knowledge and skills taught in didactic and laboratory settings of instruction.

Course Descriptions:

GE011: Anatomy & Physiology

In this course, the essential basics of structures and functions of the human body systems will be discussed. Topics on all individual major organ systems will be examined, while considering them in the state of health versus the state of disease, focusing mainly on structures. Various clinical implications and possible deviations from norm of each organ system will be brought up throughout the course.

GE112: Algebra I

This course is designed to give students the math skills that provide a foundation for more advanced courses. Students will explore writing and solving linear and nonlinear equations, powers and exponents, quadratic equations, polynomials and factoring, graphing and solving linear inequalities, and functions.

GE130: Written and Oral Communication

In this course, students will explore the fundamental analog and digital skills of oral and written communication to help create professional written and oral communication within their career. This is an introduction to a variety of methods used to communicate effectively and create language that articulates information in a way that connects a speaker to an audience.

C100a: Anatomy & Physiology / Pathophysiology / Therapeutic Communications / HIPAA

Covers the principles of human anatomy and physiology with emphasis on the cardiovascular system. Topics include cell biology, normal anatomy and physiology of the cardiovascular, respiratory, urinary, nervous, and endocrine systems. The format includes class discussion, and a high degree of student participation on the major pathologies of each organ system presented. Emphasis is placed on the physiologic principles underlying the disease processes which the Cardiovascular Technologist is likely to encounter in a clinical environment. Presents the concepts of basic human behavior with emphasis on effective communication with the patient and family, physicians, and staff. Student will be able to identify styles and types of verbal and non-verbal communication and differentiate between adaptive and non-adaptive coping mechanisms. Student will recognize the role of patient advocacy as it applies to their scope of practice. Focus is placed on active listening skills and increasing awareness of how a message is received and the formation of a professional response. Communication skills incorporate respect for cultural diversity and sensitivity. HIPAA guidelines and how they pertain to the role of the allied health professional are also presented.



C101a: Physics I - Basic Ultrasound

Student learns the physical properties of ultrasound. Topics include the piezoelectric effect, the parameters of a sound wave, acoustic variables and the concept of direct and inverse relationships among variables. The student performs calculations of frequency, period, wavelength, velocity, amplitude, power, and intensity.

C115a: Pharmacology

A study of the major categories of medications prescribed for cardiac patients. The student learns the indications, contraindications, and mechanisms of action of drugs used for the control of angina, dysrhythmias, heart failure and hypertension. Adrenergics and anticoagulants are covered. Selected ancillary medications for sedation, analgesia, diuresis, and cardiopulmonary emergencies are also examined.

C118a1: ECG I - Theory

A study of the basic levels of electrocardiology and electrocardiography. Focus is placed on waveform morphology with emphasis on Einthoven's theory and lead derivation. Student learns to perform ECG measurements of significant diagnostic value. Ancillary ECG methods such as telemetry monitoring and stress testing are also presented. ECG I is a prerequisite for the study of advanced principles offered in ECG II.

C118a2: ECG I – Practical – Telemetry & Exercise Stress Testing

Hands-on ECG testing procedures and placement of chest electrodes. Principles of machine operations and troubleshooting to maintain quality of ECG tracing is thoroughly covered. Technical skills are performed under the supervision of credentialed specialists to ensure quality control and professional skill development.

C100b: Anatomy & Physiology / Pathophysiology

This course is designed to continue the principles of human anatomy and physiology introduced in C100a Anatomy & Physiology/Pathophysiology which have a direct relationship to the function of cardiac activity and blood flow. Focus is placed on feedback mechanisms underlying circulatory physiology. Anatomy and physiology of the heart is discussed with focus placed on myocyte contraction, cardiodynamics, and basic cardiovascular pathology. Discussion also includes nervous, endocrine, respiratory and renal function as it relates to the cardiovascular system.

C101b: Physics II - Pulsed Ultrasound

Student learns the principles of pulsed ultrasound and the behavior of sound as it propagates through the body. Topics include pulsed ultrasound, attenuation, impedance reflection and refraction. The student performs calculations of pulse repetition frequency, pulse repetition period, spatial pulse length, pulse duration, duty factor, attenuation coefficient, intensity reflection coefficient and Snell's Law of Refraction.

C115b: Pharmacology



This course is designed to continue the principles of Pharmacology introduced in C115a. This course involves the study of adrenergics, antiarrhythmics, antihypertensives & nitrates. The student will also learn the medications used for each of the above referenced modules, including the mechanism of action, indications, side effects, contraindications and/or interactions.

C110: Vital Signs: Theory & Practical / IV Administration: Theory & Practical

Prepares student to perform blood pressure, pulse, and respiration procedures. Hands-on practice is supervised by credentialed subject specialists to ensure quality control and successful development of clinical skills. Trains the student in the proper procedural techniques for IV administration. Special attention is given to sites and equipment which may be used for IV infusion. Supervised hands-on training (1-1 ratio) for all intravenous procedures is closely monitored by certified subject specialists to ensure quality control and to instill professional confidence. IV administration labs are limited in size for the successful development of IV administration skills. Focus is placed on OSHA guidelines and how this pertains to the role of the allied health professional.

C128b1: ECG II - Theory

Builds on the basic principles of waveform morphology presented in ECG I. The student develops the ability to recognize and interpret cardiac arrhythmias, heart blocks, chamber enlargement, and 12-lead interpretation as it relates to myocardial infarction, and pacemaker analysis.

C128b2: ECG II Practical – 12-Lead Analysis, Arrhythmia Interpretation

Student develops expertise in the recognition and interpretation of cardiac arrhythmias, heart blocks, and chamber enlargement. Special attention is also given to the recognition of pacemaker patterns and ECG changes caused by a myocardial infarction. The student is required to interpret and analyze numerous rhythm strips for each cardiac anomaly.

C129 Healthcare Provider Basic Life Support

This is a programmed course designed and supported by the American Heart Association. Student learns to accurately identify an emergency and provide appropriate care for the adult, child, and infant. Emphasis is placed on skill development in CPR, AED and rescue breathing. In addition, the Healthcare Provider Basic Life Support training is designed and supported by the American Heart Association. Student learns to accurately identify an emergency and provide appropriate care for the adult, child, and infant. Emphasis is placed on skill development in CPR, AED and rescue breathing.

C130a: Echocardiography I - Theory

Provides the basic principles of 2-Dimensional adult echocardiography and M-Mode echocardiography. Basic ultrasound physics and abnormal M-Mode echocardiography are also presented. Utilization of sanitized digital media of echocardiography recordings and case histories from the American College of Cardiology, Mayo Clinic series, assist in reinforcing course principles. Emphasis is placed on integration of theory with practical laboratory performance.



C101c: Physics III - Doppler Physics

Student learns the principles of Doppler ultrasound including: Doppler shift, spectral analysis, the Fast Fourier transform, and the Nyquist Limit. The student performs calculations of the Doppler Equation, the Range Velocity Equation, the Nyquist Limit.

C130b: Echocardiography I - Practical

Extensive hands-on application is designed to develop student competence in views presented in theory courses. Student develops significant skills while performing echocardiograms utilizing ultrasound equipment at the school. Student acquires technical ability under the supervision of credentialed specialists to ensure quality control and professional skill development. Performance check-offs are conducted routinely as each view is practiced and completed.

C230a: Echocardiography II – Theory Cardiac Doppler & Pathology

Provides the principles of Doppler physics, Doppler assessment of the mitral valve, and identification of mitral valve pathology. Doppler assessment of the aortic valve and identification of aortic valve pathology is also presented. Utilization of sanitized digital media of echocardiography recordings and case histories from the American College of Cardiology, Mayo Clinic series, assist in reinforcing course principles. Emphasis is placed on integration of theory with practical laboratory performance.

C201a: Physics IV - Transducers

Student learns the principles of ultrasound beam formation, transducer array designs and image display. Topics include echo ranging, spatial and temporal resolution, components of the transducer, bandwidth, and real time imaging. The student performs calculations of axial and lateral resolution, focal depth and beam divergence.

C230b: Echocardiography II – Practical Cardiac Doppler

Extensive hands-on application is designed to develop student competence in views presented in theory courses. Student develops significant skills while performing echocardiograms utilizing ultrasound equipment at the school. Student acquires technical ability under the supervision of credentialed specialists to ensure quality control and professional skill development. Performance check-offs are conducted routinely as each view is practiced and completed.

C240a: Echocardiography III – Theory, Cardiac Valve Pathology

Presents the principles of left ventricular function, pericardial disease, cardiomyopathies, cardiac tumors and valvular diseases. Special attention is given to their identification in the use of cardiac ultrasound. Utilization of sanitized digital media of echocardiography recordings and case histories from the American College of Cardiology, Mayo Clinic series, assist in reinforcing course principles. Emphasis is placed on integration of theory with practical laboratory performance.

C201b: Physics V - Instrumentation

Student learns the principles of ultrasound system components and instrumentation. Topics include output power versus receiver gain, ALARA, analog to digital conversion, display controls and



magnification. The student performs calculations of shades of gray given bits of memory and dynamic ranges of system components.

C240b: Echocardiography III – Practical Cardiac Doppler

Extensive hands-on application is designed to develop student competence in views presented in theory courses. Student develops significant skills while performing echocardiograms utilizing ultrasound equipment at the school. Student acquires technical ability under the supervision of credentialed specialists to ensure quality control and professional skill development. Performance check-offs are conducted routinely as each view is practiced and completed.

C250a: Echocardiography IV – Theory, Cardiac Pathology

Provides the principles of Doppler assessment of right heart valves, and pulmonary and tricuspid valve pathology. Doppler assessment of prosthetic heart valves and left ventricular pathology is also presented. Emphasis is placed on the integration of all previously presented views and the performance of the complete echo examination and required final reports. Utilization of sanitized digital media of echocardiography recordings and case histories from the American College of Cardiology, Mayo Clinic series, assist in reinforcing course principles. Emphasis is placed on integration of theory with practical laboratory performance.

C201c: Physics VI - Quality Assurance & Artifacts

Student learns the principles of artifacts, bioeffects and quality assurance. Topics include types and causes of image artifacts, quality assurance phantoms, performance measurements, instruments for measuring bioeffects, thermal and cavitation mechanisms and epidemiologic studies. The student performs calculations of Mechanical Index.

250b: Echocardiography IV – Practical Color Flow

Extensive hands-on application is designed to develop student competence in views presented in theory courses. Student develops significant skills while performing echocardiograms utilizing ultrasound equipment at the school. Student acquires technical ability under the supervision of credentialed specialists to ensure quality control and professional skill development. Performance check-offs are conducted routinely as each view is practiced and completed.

C260a – C260d: Externship

Externship can take place when the student reaches eligibility and continues until externship requirement is completed. Externship is an opportunity for a learning experience outside school facilities. The off-campus externship is an integral part of the program. The student is assigned to a school-approved facility. Written and verbal contact with externship preceptor is maintained throughout externship experience and communication is routinely performed by the school to monitor student progress.

Maximum number of students in a classroom and laboratory:

Delivery	Faculty	Students
Classroom (Theory) Core Courses	1	25



Delivery	Faculty	Students
Laboratory (Practical) Core Courses	2	12
General Education Courses	1	25

Requirements For Graduation:

An Associate of Occupational Science degree, designating the graduate as a Cardiovascular Technologist is conferred on those students meeting the following requirements:

Satisfactory completion of the course requirements which include stipulated externship hours at a school approved site and an externship evaluation from the medical supervisor.

- A combined average grade of not less than 80%.
- A Minimum Cumulative Completion Rate of 67%.
- Recommendation of the faculty.
- Satisfaction of all indebtedness to the school.
- A satisfactory record of attendance.