**University of Hawai'i**
**Code Request Form for Academic Programs**

# NEW OR REPLACE PROGRAM CODE

☒ **New Program Code** ☐ **Replace Program Code** Date: May 3, 2023

## REQUESTOR CONTACT INFORMATION

| | | | |
|---|---|---|---|
| Name | Charles Sasaki | Campus | Windward CC |
| Title | Vice Chancellor for Academic Affairs | Email | kevinkm@hawaii.edu (Kevin Morimatsu) |
| Office/Dept | Academic Affairs | Phone | (808) 235-7495 |

## NEW PROGRAM CODE TO CREATE

| | | | |
|---|---|---|---|
| Institution | WIN - Windward Community College | Campus | WIN - Windward Community College |
| Level | UG - Undergraduate | Effective Term | Fall 2023 |

| | | Code (Max. Characters) | Description | Check if requesting new code: |
|---|---|---|---|---|
| College | (2) | IN | Instructional | ☐ See Banner form STVCOLL |
| Department | (4) | LBRT | Associate in Arts in Liberal Arts | ☐ See Banner form STVDEPT |
| Degree/Certificate | (6) | ASC | Academic Subject Certificate | ☐ See Banner form STVDEGC |
| Major ~~Major~~ Concentration | (4) | AOP ~~LBRT~~ | Aeorospace Option Program ~~Liberal Arts~~ | ☒ See Banner form STVMAJR |
| Concentration | (4) | | | ☐ See Banner form STVMAJR |
| Minor | (4) | | | ☐ See Banner form STVMAJR |

If a similar major/concentration code exists in Banner, please list the code:

Justification to warrant a new major/concentration code similar to an existing major/concentration code:

No campus in the UHCC system offers an AOP certificate. UHCC campuses that are affiliated with Hawaii Space Grant Consortium (HSGC) have expressed an interest in establishing an AOP certificate and would use WCC's AOP certificate as a model to develop one on their own campus.

Is this major/concentration code being used the same way at the other UH campuses? ☐ Yes ☒ No

Should this program be available for applicants to select as their planned course of study on the online application? *If yes, student may select the code as their only program of study.* ☐ Yes ☒ No

### RULES PERTAINING TO FINANCIAL AID AND 150% DIRECT SUBSIDIZED LOAN LIMIT LEGISLATION

Is 50% or greater of the classes in this program offered at a location other than the Home Campus? ☒ Yes ☐ No

Is this program/major/certificate financial aid eligible? ☐ Yes ☒ No

Does this certificate qualify as a Gainful Employment Program (Title IV-eligible certificate program)? ☐ Yes ☒ No

*See http://www.ifap.ed.gov/GainfulEmploymentInfo/index.html*

Program Length

*In academic years; decimals are acceptable. The length of the program should match what is published by the campus in any online and or written publication.* 1 year

Special Program Designations ☐ A ☐ B ☒ N ☐ P ☐ T ☐ U

*See Special Program Designations Code Definitions on IRAO Program Code Request webpage*

Required Terms of Enrollment: ☒ Fall ☒ Spring ☐ Summer ☐ Extended

Form modified: Oct 20208

**University of Hawai'i**
**Code Request Form for Academic Programs**

# NEW OR REPLACE PROGRAM CODE

## EXISTING PROGRAM CODE TO REPLACE, IF APPLICABLE

| | | | |
|---|---|---|---|
| Program Code | | Program Description | |
| Institution | | Campus | Windward CC |
| College | | Department | |
| Level | | | |

Are current students "grandfathered" under the program code? ☐ Yes ☐ No

Should the old program code be available for use in Banner? ☐ Yes ☐ No

**Effective** [ ] **, old program code will no longer be available to admit or recruit students.**
Term (ie. Fall 2020)

*This will turn off the online application, recruitment (effects Banner forms SRASUMI and SRAQUIK) and admissions (effects Banner forms SAADCRV, SAAADMS, SAASUMI, SAAQUIK, and SAAQUAN) Banner modules.*

**Effective** [ ] **, old program code will no longer be available to award degree to students.**
Term (ie. Fall 2020)

*This will turn off the general student (effects Banner form SGASTDN) and academic history (effects Banner form SHADEGR) Banner modules.*

## ATTACHMENTS

**BOR Approved:** Sole-credential Certificate, Associate, Bachelor and Graduate Degrees, and sole credential certificates

☐ BOR Meeting Minutes & Supporting Documents ☐ Curriculum

**Chancellor Approved:** Concentrations, Certificates and Associate in Technical Studies (ATS) Degree

☒ Memo from Chancellor to notify Vice President for Academic Planning and Policy regarding program action.

☒ Curriculum

**CERTIFICATES ONLY: Please check one (1) statement.** This certificate is a...

☐ BOR approved certificate. BOR Meeting/Approval Date: _____

☒ Chancellor approved within an authorized BOR program. BOR Program: Associate in Arts in Liberal Arts

☐ Chancellor approved CO in accordance with UHCCP 5.203, Section IV.B.10.

## VERIFICATIONS

***By signing below, I verify that I have reviewed and confirm the above information that is pertinent to my position.***

| **Registrar** (Print Name) | **Financial Aid Officer** (Print Name) | **For Community Colleges, verification of consultation with OVPCC Academic Affairs:** |
|---|---|---|
| Farah Doiguchi | Anna Chamberlain | ~~Della Teraoka~~ Tiana Loo |
| Signature 05/04/2023 Date | Signature 5/4/23 Date | Signature 5/4/23 Date |

## ADDITIONAL COMMENTS

Form modified: Oct 2020

UNIVERSITY of HAWAI'I
WINDWARD
COMMUNITY COLLEGE

Office of the Chancellor

May 3, 2023

**MEMORANDUM**

TO: Della Teraoka
Associate Vice President for Academic Affairs

FROM: Ardis Eschenberg
Chancellor

SUBJECT: Program Actions at Windward Community College

I have approved the following program actions on March 29, 2023, effective Fall 2023:

**New**
Academic Subject Certificate (ASC) – Aerospace Option Program

CC: Farah Doiguchi, Registrar
Jennifer Brown, Interim Vice Chancellor of Student Affairs

45-720 Kea'ahala Road
Kāne'ohe, HI 96744
Telephone: (808) 235-7402
Fax: (808) 247-5362

UNIVERSITY of HAWAI'I
WINDWARD
COMMUNITY COLLEGE

# Windward Community College
# Program Proposal

**Proposed Program Name**: Aerospace Option Program

**Date proposal submitted via email to Curriculum Chair** *(signatures 1-4 on final page are required prior to submitting to Curriculum Committee)*:

**Date of proposed program implementation**: Fall 2023

**Type of Program or Certificate:**

___ Associate of Arts*
___ Concentration in Associate of Arts
___ Associate of Science*
___ Concentration in Associate of Science
___ Certificate of Achievement (CA)*
___ Certificate of Competence (CO)
_√_ Academic Subject Certificate (ASC)
___ Other: _____

*AA, AS, and CA degrees require an approved Authorization to Plan form prior to submitting the Program Proposal form.

## i. Catalog Description of the Program

The Aerospace Option Program (AOP) is designed to assist undergraduate students interested in pursuing aerospace science and engineering careers—especially in the fields of astronomy, astronautics, aeronautics and atmospherology. Through AOP, students may add an aerospace designation to their own major while earning an official University of Hawai'i Certificate, which is registered on their transcript. AOP emphasizes experiential, hands-on learning by applying traditional STEM coursework to real-world, project-based research and internships. AOP is managed through WCC's Center for Aerospace Education in affiliation with the Hawai'i Space Grant Consortium.

UNIVERSITY of HAWAI'I
WINDWARD
COMMUNITY COLLEGE

# Windward Community College
# Program Proposal

## ii. Program Learning Outcomes

After completing this program, graduates will be able to:

- identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics.
- conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty.
- communicate with strong verbal and written skills when presenting and writing engineering and scientific reports both to the professional and layman audience.
- utilize fundamental STEM skills to advance in their educational studies and successfully compete for technical, engineering and science positions in the local, national and global workforce.

## iii. Courses connected to the Program

### Required courses (alpha and number, title, description, SLOs, credits):

Students are required to design and engage in an aerospace-related research project. This capstone requirement may be fulfilled in one of two ways:

- SCI 295EN: Introduction to STEM Research in Engineering (1 credit)
- SCI 295AS: Introduction to STEM Research in Aerospace Science (1 credit).

During this capstone course the student must be engaged in an aerospace or engineering research project conducted under the auspices of Hawaii Space Grant Consortium or similar aerospace-related granting agency. The student is required to make a presentation of his/her project at a public venue such as the HSGC Fellowship Symposium.

### Elective courses (alpha and number, title, description, SLOs, credits):

Minimum 13-credit course work earned in any astronomy, engineering, physics, chemistry, geoscience, or ICS undergraduate courses listed in the electives below. Note: Certain restrictions for these elective courses are listed below.

UNIVERSITY of HAWAI'I
WINDWARD
COMMUNITY COLLEGE

# Windward Community College
# Program Proposal

**ASTR 110: Survey of Astronomy**
Introduction to the astronomical universe for non-science students.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Outline the development of astronomy from ancient times to present and explain the role of the scientific method in this historic context.
- Describe and explain the apparent motions of the celestial bodies, especially as related to naked-eye observations.
- Identify the appropriate instruments used by astronomers to understand the universe.
- Outline the origins of our solar system and appraise the leading cosmological theories of the origin of the universe.
- Describe the physical and chemical properties of the objects in our solar system and apply the concept of comparative planetology.
- Describe the physical and chemical nature of stars, and especially our sun, and apply the astronomical techniques used to measure stellar properties.
- Outline the evolutionary stages in a star's life and compare and contrast the structure of our Milky Way and other galaxies.
- Apply astronomical concepts to the search for extraterrestrial life.

**ASTR 110L: Survey of Astronomy Lab**
Demonstration of astronomical principles through laboratory observations and analysis of astronomical data. Not required for ASTR 110.
**Credits:** 1 (Lab)
**Student Learning Outcomes:**

- Apply the scientific method to a selected group of topics in astronomy.
- Collect, report and analyze data obtained in a laboratory and/ or observatory setting in a manner exhibiting organization, proper documentation and critical thinking.
- Demonstrate a basic understanding of the use of standard astronomical instruments.
- Perform image analysis, especially as related to astronomical photographic data.
- Identify environmental factors, which affect the outcome of an experiment or observation and apply basic error analyses techniques.
- Demonstrate a working knowledge of computer on-line and Internet astronomical programs.

**ASTR 170: Introduction to Rocketry**
This is a general introductory course to rocket science. Principles of propulsion, aerodynamics, and safety protocols for design and ground operations are stressed.
**Credits:** 3 (Lecture)
**Student Learning Outcomes:**

- Demonstrate a solid understanding of propulsive methods, especially as pertains to space.
- Solve applicable problems of spacecraft kinematics, dynamics, and energy considerations.
- Apply the laws of planetary motion and celestial mechanics.
- Outline the historical development of manned and unmanned space flight.
- Identify and describe the appropriate instruments, detectors and space probes used by astronomers and space scientists to explore the solar system, especially in the area of remote sensing.
- Discuss the future of space colonization and exploitation.

UNIVERSITY of HAWAI'I
WINDWARD
COMMUNITY COLLEGE

# Windward Community College
# Program Proposal

**ASTR 180: Planetary Astronomy**
A survey of modern solar system astronomy with emphasis on the underlying physical principles. Topics discussed include the celestial sphere and aspects of the night sky, the structure and evolution of the Sun's planetary system, comparative planetology, and theories of the formation of planetary systems. Intended for science majors and prospective science teachers.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Outline the development of planetary astronomy from ancient times to present and explain the role of the scientific method in this historic context.
- Describe the major geological and atmospheric features of the objects in our Solar System.
- Describe the physical and chemical properties of the objects in our solar system and apply the concept of comparative planetology.
- Outline the origins of our Solar System and formulate models that explain the different physical and chemical characteristics of objects within the Solar System.
- Describe the properties of our Sun and their effects on objects in the Solar System.
- Outline techniques for discovering extrasolar planets and extraterrestrial life.

**ASTR 181: Stellar Astronomy**
A survey of modern stellar, galactic, and extragalactic astronomy, with emphasis on the underlying physical principles. Topics covered include stellar structure, interstellar environments and the formation of stars, stellar evolution and death, the structures of galaxies, and cosmology. Intended for science majors and prospective science teachers. The student should have a good operational familiarity with high school algebra.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Outline the development of stellar astronomy from ancient times to present and explain the role of the scientific method in this historic context.
- Identify the appropriate instruments used by astronomers to understand the universe and describe the nature of electromagnetic radiation and its role in deciphering the mysteries of stellar astronomy.
- Describe the physical and chemical nature of stars, and especially our sun, and apply the astronomical techniques used to measure stellar properties.
- Outline the evolutionary stages in a star's life, including the role of the interstellar medium.
- Compare and contrast the structure of our Milky Way and other galaxies.
- Outline and appraise the leading cosmological theories of the origin of the universe.
- Apply astronomical concepts to the search for extraterrestrial life.

**ASTR 250: Observational Astronomy**
An introduction to the tools and techniques of observational astronomy: astronomical time and coordinate systems, photometric systems and magnitudes, principles of telescopes and their operation, introduction to modern astronomical instruments, analysis of astronomical data. Includes planetary, solar and stellar observations.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Use appropriate celestial charts and astronomical time system to identify and locate celestial objects, such as stars, nebulae, galaxies, planets, satellites and asteroids.
- Describe the primary functions of an astronomical telescope and major detectors, such as spectrometers and photometers.
- Apply basic principals in planetary remote sensing and image processing.
- Outline astronomical techniques involved in observing planetary and stellar objects, such as variable stars, asteroids and the Sun and Moon.
- Compare and contrast the research involved in optical, radio, infrared and cosmic ray astronomy.
- Use appropriate techniques to analyze astronomical data.

**ASTR 250L: Observational Astronomy Lab**
A lab course in modern observational astronomy, with emphasis on "hands-on" use of instruments to acquire data with research-grade telescopes at the college's Lanihuli Observatory. Remote telescope observations may also be used. Students will gain on-site observing experience with CCD photometry and spectroscopy through direct acquisition and data analysis using modern laboratory data reduction software. Applications to planetary, solar, stellar and, where possible, galactic astrophysics will be covered.
**Credits:** 1 (lab)
**Student Learning Outcomes:**

- Use appropriate celestial charts and astronomical time system to identify and locate celestial objects, such as stars, nebulae, galaxies, planets, satellites and asteroids.
- Describe the fundamentals optics and telescopic observations.
- Operate and make observations with optical, radio and cosmic ray telescopes.
- Apply basic principals in planetary remote sensing and image processing using both real-time observations and archived data.
- Apply the techniques of astrophotography and spectrometry.
- Use appropriate techniques to analyze astronomical data.

**ASTR 281: Space Explorations**
Current topics in planetary exploration, extraterrestrial life, and space resources and colonization.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Outline the characteristics and origins of objects in our solar system, including the sun, planets, moons, meteoroids, asteroids and comets.
- Compare and contrast terrestrial and Jovian worlds and apply geological and atmospherical concepts to comparative planetology.
- Explain the effects and implications of collisional impacts on planetary surfaces.
- Apply the laws of planetary motion and celestial mechanics.
- Outline the historical development of manned and unmanned space flight.
- Identify and describe the appropriate instruments, detectors and space probes used by astronomers and space scientists to explore the solar system, especially in the area of remote sensing.
- Discuss the future of space colonization and exploitation.
- Discuss the nature and origin of life on earth and apply the astronomical concepts related to the search for extraterrestrial life.

# Windward Community College
# Program Proposal

**ATMO 101: Introduction to Weather and Climate**
Introductory (DP) Diversification Physical Science course for all undergraduates in any major. A non-mathematical introduction to basic atmospheric variables, Earth's past climates, global warming, air pollution, El Nino, hurricanes, tornadoes, and forecasting weather in Hawai'i.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Describe the components, processes and resulting weather patterns in the atmosphere.
- Interpret the components of weather maps, and forecast weather.
- Apply the scientific method and theories and concepts of meteorology (atmospheric physics) to explain major weather systems.
- Explain critically the relationship between humans and the atmospheric environment.

**CE 270: Applied Mechanics I**
This course is a study of equilibrium of rigid bodies under the action of forces and the application of the principles of mechanics to solve static problems in engineering.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Solve problems involving forces, resultant and static equilibrium and their application to rigid bodies.
- Analyze equilibrium of rigid bodies in two and three dimensions.
- Solve problems involving center of gravity, centroids, couples, and moments of inertia.
- Analyze engineering structures subjected to concentrated loads, distributed loads, and frictional forces.
- Utilize abstract thinking and analytical reasoning in the analysis of word problems dealing with mechanical structures.
- Apply calculation techniques to dynamic problems in engineering.

**CHEM 151: Elementary Survey of Chemistry**
Provides the student with an adequate background in the fundamentals of chemistry. Covers the basic language and quantitative relationships of chemistry, including atomic structure, chemical bonding, structure-property relationships, chemical reactions. Prerequisite to CHEM 152 for majors in medical technology and nursing and other allied health and science-related fields, or can be taken as a preparatory course for CHEM 161.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Predict properties of chemical elements based on their atomic structure and their location in the Periodic Table.
- Name chemical compounds, balance chemical and nuclear reactions.
- Predict properties of chemical compounds based on chemical bonding, molecular shapes, and polarity.
- Calculate mass relationships in chemical reactions and the quantity of matter in gaseous chemicals and chemical solutions.
- Predict the products of common chemical reactions.
- Apply knowledge of chemical concepts to a current environmental, health, industrial, or technological issue or condition by writing a short research paper.

UNIVERSITY of HAWAI'I
WINDWARD
COMMUNITY COLLEGE

# Windward Community College
# Program Proposal

**CHEM 151L: Elementary Survey of Chemistry Lab**
Experiments introducing laboratory techniques and illustrating chemical principles; supplemented by films, demonstrations, and problem sessions.
**Credits:** 1 (lab)
**Student Learning Outcomes:**

- Identify and locate laboratory safety equipment and apply laboratory safety procedures.
- Assemble apparatus to perform common laboratory techniques to verify basic chemistry laws on gases, chemical stoichiometry, chemical equilibrium and others.
- Use molecular models and technology to investigate chemistry concepts.
- Make and record accurate observations, precise measurements and calculations applying rules on significant figures.
- Develop hypotheses, use critical thinking to process results and identify sources of error.
- Apply and articulate the scientific method by preparing a lab report using the standard scientific format.

**CHEM 161: General Chemistry I**
Basic principles of inorganic chemistry with an emphasis on problem solving. First course of a two-course sequence designed to meet the one-year General Chemistry requirement for pre-med, science and engineering majors. Topics include chemical calculations, electronic structure, chemical bonding, states of matter and solutions.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Use the mole concept in solving stoichiometry problems involving solids, liquids, gases and solutions.
- Balance chemical equations, classify reactions, identify and analyze the role of the chemicals involved in chemical reactions.
- Predict the behavior of gases while undergoing changes in volume, pressure, temperature and quantity.
- Manipulate thermochemical equations and calculate the amount of energy involved in chemical reactions.
- Predict physical and chemical properties of elements based on electronic structure and location in the Periodic Table.
- Predict physical and chemical properties of compounds based on chemical bonding, geometry and intermolecular interactions.

**CHEM 161L: General Chemistry I Lab**
Laboratory experiments illustrating fundamental principles of chemistry.
**Credits:** 1 (lab)
**Student Learning Outcomes:**

- Apply laboratory safety procedures and respond to hazards.
- Use molecular and crystal models, perform common laboratory techniques competently and computer-based experiments to verify chemistry laws on stoichiometry, thermochemistry, behavior of gases and liquids.
- Apply and articulate the scientific method by preparing lab reports using the standard scientific format. Express in writing core chemistry principles, results of experiments and do critical thinking by synthesizing conclusions based on observations and data.

- Make and record precise measurements, calculate results using significant figures, standard deviations and identify sources of error in laboratory experiments.
- Use computer competently, word-processing, spreadsheet and graphing.
- Prepare chemical solutions, perform dilutions, calculate solution concentrations and generate a calibration curve.

**CHEM 162: General Chemistry II**
Second course of a two-course sequence designed to meet the one-year General Chemistry requirement for pre-med, science and engineering majors. Topics include thermochemistry, kinetics, acid-base equilibrium, solubility equilibrium and electrochemistry. Emphasis on problem solving.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Predict properties of pure substances using phase diagrams.
- Predict properties (boiling point, melting point, osmotic pressure, vapor pressure) of solutions based on concentration.
- Determine reaction rate law and calculate rate constants and half-life based on experimental data.
- Calculate the equilibrium concentration of chemicals in solution involved in precipitation, and acid-base and reactions.
- Predict spontaneous reactions based on enthalpy and entropy considerations.
- Determine the electrochemical potential of redox reactions.

**CHEM 162L: General Chemistry II Lab**
Laboratory experiments illustrating fundamental principles of chemistry.
**Credits:** 1 (lab)
**Student Learning Outcomes:**

- Develop an appreciation for the methods of scientific inquiry through computer-based laboratory experiments showing real-time data.
- Apply knowledge to determine molar mass of unknown substance using freezing point depression data of solution.
- Calculate chemical reaction rate and constant using graphing analysis.
- Predict the effects of concentration and temperature changes on equilibrium mixtures using Le Chatelier's principle.
- Determine whether equilibrium is established and calculate equilibrium concentrations/constants and cell potentials.
- Apply and articulate the scientific method by preparing lab reports using the standard scientific format. Express in writing core chemistry principles, results of experiments and do critical thinking by synthesizing conclusions based on observations and data.

**EE 160: Programming for Engineers**
Introductory course on computer programming and modern computing environments with an emphasis on algorithm and program design, implementation and debugging. Designed for engineering students, this course includes a hands-on laboratory to develop and practice programming skills.
**Credits:** 4 (lecture)

**Student Learning Outcomes:**

- explain the steps involved in the programming process.
- solve simple problems and express those solutions as algorithms.
- use the fundamental techniques of selection, looping, assignment, input, and output to describe the steps the computer takes to solve a problem.
- write algorithms and code in a top-down manner.
- work with arrays in searching and sorting applications.
- work with structures and unions types.
- write, test, and debug small programs.
- write functions and use pointers.
- work with characters and strings.
- work in text based environment like UNIX.
- interface with text base using a GUI interface.

**EE 211: Basic Circuit Analysis I**

This is an introductory course covering linear passive circuits, time domain analysis, transient and steady state responses, phasors, impedance and admittance, power and energy, frequency responses, and resonance.

**Credits:** 4 (lecture/lab)

**Student Learning Outcomes:**

- Analyze and assemble basic circuits.
- Describe and analyze the basic functionality of the components of a basic circuit.
- Describe the rudiments of electric power production.

**ERTH 101: Dynamic Earth**

The natural physical environment; the landscape; rocks and minerals, rivers and oceans; volcanism, earthquakes and other processes inside the Earth; effects of human use on the Earth and its resources. Field trip.

**Credits:** 3 (lecture)

**Student Learning Outcomes:**

- Explain the relevance of geology and geophysics to human needs, including those appropriate to Hawai'i, and be able to discuss issues related to geology and its impact on society and planet Earth.
- Apply technical knowledge of relevant computer applications, laboratory methods, and field methods to solve real-world problems in geology and geophysics.
- Use the scientific method to define, critically analyze, and solve a problem in earth science.
- Reconstruct, clearly and ethically, geological knowledge in both oral presentations and written reports.
- Evaluate, interpret, and summarize the basic principles of geology and geophysics, including the fundamental tenets of the sub-disciplines, and their context in relationship to other core sciences, to explain complex phenomena in geology and geophysics.

**ERTH 101L: Dynamic Earth Laboratory**

Hands-on study of minerals, rocks, and topographic maps. Examine volcanism, hydrology, coastal processes and hazards, geologic time and earthquakes. Field trips to investigate landslides, beaches and O'ahu geology.

**Credits:** 1 (lab)

**Student Learning Outcomes:**

- Explain the relevance of geology and geophysics to human needs, including those appropriate to Hawai'i, and be able to discuss issues related to geology and its impact on society and planet Earth.
- Apply technical knowledge of relevant computer applications, laboratory methods, and field methods to solve real-world problems in geology and geophysics.
- Use the scientific method to define, critically analyze, and solve a problem in earth science.
- Reconstruct, clearly and ethically, geological knowledge in both oral presentations and written reports.
- Evaluate, interpret, and summarize the basic principles of geology and geophysics, including the fundamental tenets of the sub-disciplines, and their context in relationship to other core sciences, to explain complex phenomena in geology and geophysics.

**ICS 111: Introduction to Computer Science I**

Intended for computer science majors and all others interested in a first course in programming. An overview of the fundamentals of computer science emphasizing problem solving, algorithm development, implementation, and debugging/testing using an object-oriented programming language.

**Credits:** 3 (lecture)

**Student Learning Outcomes:**

- Use an appropriate programming environment to design, code, compile, run, and debug computer programs.
- Demonstrate basic problem solving skills: analyzing problems, modeling a problem as a system of objects, creating algorithms, and implementing models and algorithms in an object-oriented computing language.
- Illustrate basic programming concepts such as program flow and syntax of a high-level general purpose language and basic security practices.
- Demonstrate working with primitive data types, strings, and arrays.

**ICS 211: Introduction to Computer Science II**

Reinforce and strengthen problem-solving skills using abstract data types and introduce software development practices. Emphasize the use of searching and sorting algorithms and their complexity, recursion, object-oriented programming, and data structures.

**Credits:** 3 (lecture)

**Student Learning Outcomes:**

- Use and implement abstract data types such as lists, stacks, queues, and trees.
- Select the appropriate searching or sorting algorithm based on the algorithm's behavior.
- Develop recursive algorithms and programs.
- Use standard libraries or packages as well as advanced object-oriented programming techniques (polymorphism, inheritance, and encapsulation).
- Produce robust and secure programs using exception handling and extensive program testing.

**ICS 212: Program Structure**
Program organization paradigms, programming environments, implementation of a module from specifications, the C and C++ programming languages.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Use an editor, make file, and compiler in the UNIX environment.
- Use recursion, arrays, pointers, character variables, bitwise operators, structures, and linked data structures in C.
- Use classes (constructors, destructor, and overloading assignment), operator overloading, inheritance, and polymorphism in C++.
- Use linked data structures and recursion in C++.
- Use standard C++ strings and C++ STL library data structures, such as STL lists.

**ICS 215: Introduction to Scripting**
Introduction to scripting languages for the integration of applications and systems. Scripting in operating systems, web pages, server-side application integration, regular expressions, event handling, input validation, selection, repetition, and parameter passing for languages such as Perl, JavaScript, PHP, Python, and/ or shell scripting.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Use regular expressions to solve different problems.
- Produce robust client and server side scripts in a variety of scripting languages using software engineering techniques such as review and extensive program testing.
- Handle user and system generated events using various scripting languages.
- Validate user input using various scripting languages for security purposes.

**PHYS 151: College Physics I**
A noncalculus one semester course for preprofessional or nonengineering majors. Study of the basic concepts of physics, including the fundamental principles and theories in mechanics, energy, and waves.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Demonstrate a general understanding of the underlying philosophy of the physics, including the scientific method.
- Apply the basic concepts of physics, including mechanics, energy, simple oscillatory systems, gas laws and fluid dynamics.
- Apply the concept of conservation laws in problem solving.
- Apply basic algebraic and graphical analysis techniques to physics problems.
- Compare and contrast macroscopic and microscopic systems in physics.
- Define quantitatively and qualitatively the common terms used in physics.
- Assess the limitations of the scientific method and apply error analysis.
- Determine when to apply physics principles to everyday situations.

**PHYS 151L: College Physics I Lab**
Experiments in statics, mechanics, energy, waves, and friction.
**Credits:** 1 (lab)

**Student Learning Outcomes:**
- Apply the scientific method to physical science systems involving mechanics, energy, simple oscillatory systems, gas laws and fluid dynamics.
- Collect, report and analyze data obtained in a laboratory setting in a manner exhibiting organization, proper documentation and critical thinking.
- Manipulate data and apply quantitative techniques, such as graphing and statistical analysis.
- Demonstrate a basic understanding of the standard instruments used in physics.
- Identify environmental factors, which affect the outcome of an experiment or observation and apply basic error analyses techniques.

**PHYS 152: College Physics II**
A noncalculus, one-semester course for pre-professional or nonengineering majors. Study of the basic concepts of physics, including the fundamental principles and theories in electricity, magnetism, optics, and modern physics.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**
- Demonstrate a general understanding of the underlying philosophy of the physics, including the scientific method.
- Apply the basic concepts of physics, including thermodynamics, static and dynamic laws of electricity and magnetism, circuit analysis, electromagnetic radiation, optical systems, and the fundamentals of atomic and nuclear physics.
- Apply the concept of conservation laws in problem solving.
- Apply basic algebraic and graphical analysis techniques to physics problems.
- Compare and contrast macroscopic and microscopic systems in physics.
- Define quantitatively and qualitatively the common terms used in physics.
- Assess the limitations of the scientific method and apply error analysis.
- Recognize the physical science principles as applied to everyday situations.

**PHYS 152L: College Physics II Lab**
Experiments in electricity, magnetism, optics, and modern physics.
**Credits:** 1 (lab)
**Student Learning Outcomes:**
- Apply the scientific method to physical science systems involving thermodynamics, static and dynamic laws of electricity and magnetism, electrical and electronic circuit analysis, electromagnetic radiation, optical systems, and the fundamentals of atomic and nuclear physics.
- Collect, report and analyze data obtained in a laboratory setting in a manner exhibiting organization, proper documentation and critical thinking.
- Manipulate data and apply quantitative techniques, such as graphing and statistical analysis.
- Demonstrate a basic understanding of the standard instruments used in physics.
- Identify environmental factors, which affect the outcome of an experiment or observation and apply basic error analyses techniques.

# Windward Community College
# Program Proposal

**PHYS 170: General Physics I**
This is the first of a rigorous, calculus-based course in physics for the professional or engineering majors. The study of the concepts of physics including the fundamental principles and theories of mechanics, energy, waves and thermodynamics.
**Credits:** 4 (lecture)
**Student Learning Outcomes:**

- Demonstrate a solid conceptual understanding of kinematics, dynamics, wave phenomena, and thermodynamics.
- Solve applicable problems using differential calculus and vector analysis.
- Apply the laws of physics to computational problems in kinematics, dynamics, wave phenomena, and thermodynamics.

**PHYS 170L: General Physics I Lab**
This laboratory course is a rigorous, calculus-based study for professional or engineering majors. Laboratory exercises are designed to reinforce the fundamental concepts of kinematics, mechanics, energy, waves and thermodynamics. (3hourslaboratory)
**Credits:** 1 (lab)
**Student Learning Outcomes:**

- Demonstrate an experimental understanding of some basic physical concepts and theories.
- Demonstrate familiarity with various instruments and their use in making reliable and precise measurements.
- Calculate a result with the appropriate number of significant figures.
- Analyze data using calculation and graphical methods.
- Organize an accurate and complete laboratory notebook.

**PHYS 272: General Physics II**
This is the second in a rigorous, calculus-based physics course for the professional or engineering major. The study of the concepts of physics including the fundamental principles and theories of electricity, magnetism, light, and optical theory.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Demonstrate a solid conceptual understanding of electricity, magnetism, light, and optical theory.
- Solve applicable problems using calculus and vector analysis.
- Apply the laws of physics to computational problems in electricity, magnetism, and wave phenomena.

**PHYS 272L: General Physics II Lab**
This laboratory course is a rigorous, calculus-based study for professional or engineering majors. Laboratory exercises are designed to reinforce the fundamental concepts of electricity, magnetism, light and optical theory.
**Credits:** 1 (lab)
**Student Learning Outcomes:**

- Demonstrate experimental understanding of some basic physical concepts and theories.
- Demonstrate familiarity with various instruments and learn to make reliable measurements.
- Calculate a result with the appropriate number of significant figures.
- Analyze data using calculation and graphical methods.
- Organize an accurate and complete laboratory notebook.

**PHYS 274: General Physics III**
This course focuses on the study of physical optics, special relativity, quantum mechanics, solid state physics, atomic and nuclear physics, and elementary particle physics.
**Credits:** 3 (lecture)
**Student Learning Outcomes:**

- Describe the theory of special relativity and its effects: time dilation and space contraction.
- Describe the particle like properties of electromagnetic radiation as demonstrated in the photoelectric effect and Compton scattering.
- Analyze the wavelike properties of matter known as quantum theory.
- Identify and Describe knowledge of the different properties of solids such as crystal structure, thermal and magnetic properties, and superconductivity.
- Describe nuclear structure, radioactive decay, nuclear interactions, and their applications.
- Identify the different elementary particles and describe their role in the forces that hold matter together.

**SCI 295EN: Introduction to STEM Research in Engineering**
SCI 295EN offers a research experience in science, technology, engineering, and/or mathematics that emphasizes the application of the scientific method to a specific project in engineering. Repeatable for up to 6 credits. (3 hours cooperative education/work experience per week per credit)
**Credits:** variable 1-3 (research)
**Student Learning Outcomes:**

- Use research and technology skills to access information from multiple sources.
- Design and implement a plan to solve a specific STEM-based research project.
- Collect, analyze and interpret data generated by the selected research project.
- Communicate conclusions in written and/or oral form.

**SCI 295AS: Introduction to STEM Research in Aerospace Science**
SCI 295AS offers a research experience in science, technology, engineering, and/or mathematics that emphasizes the application of the scientific method to a specific project in aerospace science. Repeatable for up to 6 credits. (3 hours cooperative education/work experience per week per credit.
**Credits:** variable 1-3 (research)
**Student Learning Outcomes:**

- Use research and technology skills to access information from multiple sources.
- Design and implement a plan to solve a specific STEM-based research project.
- Collect, analyze and interpret data generated by the selected research project.
- Communicate conclusions in written and/or oral form.

UNIVERSITY of HAWAI'I
WINDWARD
COMMUNITY COLLEGE

# Windward Community College
# Program Proposal

**RESTRICTIONS for Elective Courses:**

1 Any number of the following astronomy and aeronautics courses may be applied to the 12-credit elective minimum:

ASTR 110; ASTR 110L; ASTR 170; ASTR 180; ASTR 181; ASTR 250; ASTR 250L; ASTR 281

2. Any number of the following physics courses may be applied to the 12-credit elective minimum with the specified restrictions:
PHYS 151 or PHYS 170; PHYS 151L or PHYS 170L; PHYS 152 or PHY 272; PHYS 152L or PHYS 272L; PHYS 274

3. Any number of the following engineering courses may be applied to the 12-credit elective minimum:

CE 270; EE 211

4. No more than two of the following ICS courses may be applied to the 12-credit elective minimum with the specified restrictions:
ICS 111; ICS 211; ICS 212 or EE 160; ICS 215

5. No more than three of the following chemistry and geoscience courses may be applied to the 12-credit elective minimum with the specified restrictions:

CHEM 151 or CHEM 161; CHEM 151L or CHEM 161L; CHEM 162; CHEM 162L

ATMO 101; ERTH 101, ERTH 101L

| **SUMMARY TABLE: (13 credits minimum)** | Credits | Grading (A-F, Cr/No Cr, etc.) |
|---|---|---|
| REQUIRED COURSES (Total credits: 1) | | |
| *ALPHA Number and Course Title* | | |
| Student must complete one of the following capstone courses (SCI 295EN or SCI 295AS) during which the student is engaged in an aerospace-related research project conducted under the auspices of Hawaii Space Grant Consortium or similar aerospace-related granting agency. The student is required to make a presentation of his/her project at a public venue such as the HSGC Fellowship Symposium. | | |
| SCI 295EN: Introduction to STEM Research in Engineering. | 1 | A-F symposium presentation |

# Windward Community College
# Program Proposal

| | | |
|---|---|---|
| SCI 295AS: Introduction to STEM Research in Aerospace Science. | 1 | A-F symposium presentation |
| ELECTIVE COURSES: (minimum of 12 credits from the following elective courses— see restrictions above. | | |
| ASTR 110 Survey of Astronomy | 3 | A-F |
| ASTR 110 L Survey of Astronomy Lab | 1 | A-F |
| ASTR 170 Introduction to Rocketry | 3 | A-F |
| ASTR 180 Planetary Astronomy | 3 | A-F |
| ASTR 181 Stellar Astronomy | 3 | A-F |
| ASTR 190 Introduction to Rocketry | 3 | A-F |
| ASTR 250 Observational Astronomy | 3 | A-F |
| ASTR 250L Observational Astronomy Lab | 1 | A-F |
| ASTR 281 Space Explorations (equivalent to ME 201/EPET201) | 3 | A-F |
| ATMO 101 Introduction to Weather and Climate | 3 | A-F |
| CE 270 Applied Mechanics I | 3 | A-F |
| CHEM 151 Elementary Survey of Chemistry | 3 | A-F |
| CHEM 151L Elementary Survey of Chemistry Lab | 1 | A-F |
| CHEM 161 General Chemistry I | 3 | A-F |
| CHEM 161L General Chemistry I Lab | 1 | A-F |
| CHEM 162 General Chemistry II | 3 | A-F |
| CHEM 162L General Chemistry II Lab | 1 | A-F |
| EE 160 Programming for Engineers | 4 | A-F |
| EE 211 Basic Circuit Analysis | 4 | A-F |
| ERTH 101 Dynamic Earth | 3 | A-F |
| ERTH 101L Dynamic Earth Laboratory | 1 | A-F |
| ICS 111 Introduction to Computer Science I | 3 | A-F |
| ICS 211 Introduction to Computer Science II | 3 | A-F |
| ICS 212 Program Structure | 3 | A-F |
| ICS 215 Introduction to Scripting | 3 | A-F |
| PHYS 151 College Physics I | 3 | A-F |
| PHYS 151L College Physics I Lab | 1 | A-F |
| PHYS 152 College Physics II | 3 | A-F |
| PHYS 152L College Physics II Lab | 1 | A-F |
| PHYS 170 General Physics I | 4 | A-F |
| PHYS 170L General Physics I Lab | 1 | A-F |
| PHYS 272 General Physics II | 3 | A-F |

| | | |
|---|---|---|
| PHYS 272L General Physics II Lab | 1 | A-F |
| PHYS 274 General Physics III | 3 | A-F |

## iv. Description of demand and social value of the program

Currently, no campus in the UHCC system offers an AOP Certificate. UHCC campuses that are affiliated with Hawaii Space Grant Consortium (HSGC) have expressed an interest in establishing an AOP certificate based on the presentations made by WCC at recent HSGC Associate Directors meetings and would use WCC's AOP Certificate as a model to develop one on their own campus.

Recently, UH-Manoa's Hawaii Institute of Geophysics and Planetology has begun offering a new Earth and Planetary Exploration Technology (EPET) Certificate to prepare their undergraduate students for the workforce in space exploration and aerospace engineering. The EPET certificate program consists of four courses totaling 15 credits. These courses are cross listed with mechanical engineering and form the core of the concentration in aerospace engineering of the UHM Mechanical Engineering Department.

Besides supporting WCC's ASNS concentrations in Physical Sciences, Engineering, and Information and Communication Technology, the proposed AOP Certificate would establish a coherent pathway into UHM's EPET Certificate as well as embellish WCC's already existing articulation with UH Hilo's Astronomy BS degree program.

The recent COVID lockdown has poignantly reminded the State of Hawaii that it can no long rely on tourism for its staple economy. The Hawaii Office of Aerospace Development (OAD), which is housed in the State's Department of Business, Economic Development and Tourism (DBEDT), was established to identify and promote opportunities to expand and diversify aerospace-related businesses in Hawaii. This includes the promotion of innovative education and workforce development programs that will enhance public awareness of the State's aerospace potential and enable local citizens to pursue employment in Hawaii's aerospace industry. OAD also assists local universities, companies, research institutions, and other interested organizations in establishing partnerships with corporate, government, and educational entities overseas that can promote and enhance Hawaii's aerospace industry.

Numerous aerospace businesses and organizations already operate in the State of Hawaii. Among them are:

# Windward Community College
# Program Proposal

• UH Manoa's Hawaii Space Flight Lab (HSFL) which is a research lab with testing and integration facilities that range from avionics fabrication to environmental testing for small space payloads.

• Pacific International Space Center for Exploration Systems (PISCES) which operates under DBEDT to promote aerospace opportunities as well as innovative educational and workforce development in Hawaii's aerospace industry. It also conducts projects in the aerospace sector that can be leveraged for improvements to the State's broadband and alternative energy capabilities.

• Hawaii Space Exploration Analog and Simulation (HI-SEAS) which operates a 1,200-square-foot prototype moon and Mars habitat on Mauna Loa, in which scientists and researchers from international space agencies have conducted mission simulations.

• International Moonbase Alliance with headquarters in Honolulu is comprised of leading scientists, educators, and entrepreneurs from space agencies and industries worldwide to advance the development and implementation of an international base on the Moon.

Hawaii's aerospace workforce also includes some 700 employees who are employed by the Maunakea Observatories — with even more at the Haleakala High Altitude Observatory facilities on Maui. And besides the airline industry, Hawaii's aerospace enterprises include ventures in Unmanned Aerial Systems (UAS) such as Pathfinder and other aerial drones like the High-Altitude Platform Station (HAPS)—a large, solar-powered drone designed for stratospheric communication systems—that was tested in Hawaii.

Space launch systems in Hawaii are already being explored, as such HSFL's managerial participation in the Operationally Responsive Space-4 Mission (ORS-4) which attempted the first orbital space launch from Hawaii at the Pacific Missile Range Facility on Kauai.

Furthermore, as PISCES reported, "Aerospace opportunities can complement Hawaii's existing tourism industry. A Silicon Valley company specializing in space tourism intends to build a flight operations and manufacturing center in Hawaii. The company will ferry paying customers to the edge of space using a stratospheric balloon and space capsule. The project would create an estimated 200 jobs with average salaries of more than $60,000. The service would also support research and education related projects." Additional space tourism is anticipated from companies like Virgin Galactic, which will also offer space flights for tourists.

Overall, the workforce opportunities in Hawaii are rapidly expanding, especially now with the exponential growth of the commercial aerospace industry like SpaceX and Blue Origin.

In Hawaiian *ao* means "enlightened"— which is the ultimate goal for students participating in this AO Program.

UNIVERSITY of HAWAI'I
WINDWARD
COMMUNITY COLLEGE

# Windward Community College
# Program Proposal

## v. Description of resources needed, including budget, personnel, and facilities.

All required resources for instituting an AOP Certificate at WCC are already in place and operational. No additional resources are necessary.

The College already offers all the courses in astronomy, aeronautics, physics, engineering, chemistry, earth science and ICS that are applicable for this certificate.

This certificate would support the existing ASNS degree concentrations in Physical Sciences, Engineering, and Information and Communication Technology. Students earning an AA in Liberal Arts are also eligible for the AOP certificate.

Students in WCC's AOP would be uniquely supported by the College's Center for Aerospace Education (CAE) which manages a major complex of educational resource facilities specializing in aerospace science and engineering. These facilities include a fulldome planetarium (Hokulani Imaginarium), hands-on STEM exploratorium (Aerospace Exploration Lab), an astronomical/meteorological observatory (Lanihuli Observatory), and a high-power rocket and small payload development center (NASA Flight and Rocketry Lab).

Opened in 2002, WCC's NASA Flight and Rocketry Lab represents the first STEM center established in the UHCC system. Besides the standard equipment found in basic STEM centers (such as 3D printers, PCB milling machines and electronic fabrication stations), the NASA Flight and Rocketry Lab is equipped with a zero-drop tower, research-grade vacuum chamber and wind-tunnels, flight simulators, a spin-shake table for testing small space payloads, and a static rocket motor test facility.

In addition, this aerospace STEM center serves as the primary research lab for WCC students engaged in HSGC aerospace projects. WCC's NASA Flight and Rocketry Lab is also main headquarters for UHCC's Project Imua, which is a joint faculty-student enterprise of multiple UHCC campuses devoted to the development of high-power rockets and small payloads for space flight while providing undergraduates with project-based learning opportunities in STEM fields. Students involved in this program have already designed and constructed three payloads that were launched into space at NASA Wallops Flight Facility in Virginia. A fourth is being readied for launch this summer of 2022. The CAE Director serves as Project Manager for Project Imua.

WCC's Lanihuli Observatory provides students with research opportunities in astronomy and meteorology. This observatory consists of two complexes: Lanihuli and Lanihuli Iki. Together they house a variety of scientific instruments, including a 16-inch optical telescope, a 6-inch solar heliostat, a log-periodic radio telescope, a cosmic ray detector, and a NOAA weather satellite tracking station along with weather gauges for monitoring local weather conditions.

UNIVERSITY of HAWAI'I
WINDWARD
COMMUNITY COLLEGE

Curriculum Committee

**Academic Subject Certificate (ASC) - Aerospace Option Program**

Proposal:

_____ Date: 09/30/22 Department Chair

_____ Date: 10.4.2022 Curriculum Chair

_____ Date: 10/13/2022 Faculty Senate Chair

_____ Date: 10/20/2022 Division Dean

_____ Date: 3/28/23 Vice Chancellor

_____ Date: 3/29/23 Chancellor

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