Bellingham Technical College
Engineering Technology
Program Approval Application

Degree: Engineering Technology: Clean Energy AAS-T

	Course	Description	Goals	Learning Outcomes
Academic Coursework	MATH&141- Precalculus I	The focus of this course will be functions. Students manipulate and graph linear, polynomial, rational, exponential, logarithmic and quadratic functions. The course will also cover systems of equations, matrices and determinants, and their applications.	Analyze, solve and assess the reasonableness of solutions to practical problems that are quantitative in nature to make decisions about life issues. Recognize and interpret the meaning of mathematical symbols and apply the appropriate processes to manipulate them. Present valid written and verbal arguments to defend a numeric conclusion. Employ available technology to perform rigorous mathematical calculations.	• Sketch transformation of a parent function by hand using knowledge of shifting, reflecting, and stretching. • Graph a function on a graphing calculator, identify intercepts, asymptotes and other properties of the graph. • Evaluate combinations of functions or composite functions at a given value. • Find polynomial function real zeros. • Find rational function asymptotes and sketch it by hand, and graph it on a graphing calculator. • Sketch exponential or logarithmic function by hand and on a graphing calculator. • Create and use functions to solve various application problems. • Perform various matrix operations. • Solve system of two or more linear equations algebraically, with matrices or determinants. • Set up a system of equations and solve it using algebra, matrices or determinants.
	MATH&142- Precalculus II	The majority of this course will cover trigonometry. Students will explore trigonometry functions, right and oblique triangle trigonometry, graphing, trigonometry identifies, laws of Sine and Cosine as well as trigonometric application problems. This course will also cover vectors in the plane and in space, along with parametric equations. Polar coordinates and graphs of polar equations will also be included.	Analyze, solve and assess the reasonableness of solutions to practical problems that are quantitative in nature to make decisions about life issues. Employ available technology to simplify the computation of rigorous mathematical calculations.	• Convert between angle degree or radian measure and correctly sketch it. • Solve for the right triangle's missing measures using trigonometric functions. • Solve trigonometric equations and sketch on a graph. • Using trigonometry, solve appropriate application problems. • Calculate an angle of any size trigonometric functions. • Use fundamental trigonometric identities, simplify trigonometric expressions. • Using the Law of Sines or Cosines to solve for unknown measures of oblique triangle or an appropriate application problem. • Perform mathematical operations between multiple vectors. • Convert from polar to rectangular equations.

	MATH& 151- Calculus I	An introduction to differential calculus and the mathematical study of the rate of change of a quantity, as well as an introduction to the antiderivative. Topics include average and instantaneous rates of change, interpretation, computation, and application of derivatives to optimization, rates, graphing, and antiderivative problems.	Understand the fundamental techniques and their conceptual underpinnings, and develop problem-solving techniques and critical thinking skills. Foster an appreciation of mathematics as a vital part of study for success in highly-skilled professions and in creating opportunities for further education.	• Solve problems involving the concepts of a limit and derivative using symbolic, graphical and numerical techniques. • Interpret the meaning of the derivative in various contexts. • Use differentiation techniques (including the product rule, quotient rule, chain rule and implicit differentiation) to compute derivatives. • Solve problems involving applications of the derivative by constructing functions and computing derivatives to model situations described by words. • Solve problems involving the relationship between the graph of a function and its derivatives. • Demonstrate an understanding of the precise definition of a limit.
	ENGL& 101- English Composition I	A composition course in which students read, analyze, and write essays using a variety of rhetorical strategies, as well as develop and verbally express ideas clearly and effectively. The critical reading of essays will provide a basis for the student's own critical writing, which will reflect a command of college- level literacy standards. Attention to writing fundamentals and stylistic techniques will also be included.	Employ standard and innovative rhetorical techniques to compose focused, substantive papers with source documentation. Develop critical reading skills using a variety of text sources	• Select appropriate composition topics; effectively gather and organize material corresponding to those topics; develop essays that meet standard on the Writing Assessment Grid. • Use a variety of effective sentence and paragraph designs to convey meaning. • Analyze and employ a variety of rhetorical techniques to effectively develop a thesis. • Critically analyze assigned readings and texts orally and in writing. • Analyze and provide feedback on peer essays.
	CHEM& 161- General Chemistry w/lab I	Includes basic concepts of inorganic and organic chemistry, atomic theory, stoichiometry, periodic table, nomenclature, reactions in aqueous solutions, gases, and thermochemistry.	Describe the structure and chemical characteristics of various elements, compounds and solutions and explain how they relate to the physical and chemical changes they undergo.	• Recognize the differences between physical and chemical changes and properties. • Describe atomic structure and the differences between ionic and covalent bonds. • Use the mole concept to solve stoichiometric calculations of chemical reactions. • Solve calculations involving the gas laws and solution chemistry. • Follow proper safety guidelines for the handling and disposing of chemicals.

	PHYS& 114- General Physics w/lab I	Kinematics and dynamics of particles; work and energy; gravitation; collisions and conservation of momentum. Computer interfaced laboratory investigations, technical writing, problem solving, mathematical reasoning and scientific method of inquiry skills will be emphasized.	Understand the fundamentals of physical reasoning strategies and investigation methods.	• Demonstrate a thorough understanding of the basic principles of Newtonian dynamics, kinematics, energy and momentum. • Develop a clear understanding of the scientific method and its application to these principles. • Apply quantitative measures to situations involving these principles and develop a strong facility for working problems based on these principles. • Analyze a physical system to decide what information and principles are relevant to understanding the behavior of the systems. • Clearly communicate fundamental knowledge particular to physics with their peers using appropriate vocabulary.
	ECON& 201 MicroEconomics	Introduction to microeconomics. Presents supply and demand models, consumers and producers choice in the competitive and non-competitive market. Examines the various economic decisions made by firms relating to price, demand, factors or production, and cost.	Understand the fundamentals of analyzing simple models of choices for individual markets and industries within a mixed economy.	• Apply the theory of rational choice to explain individual behavior. • Explain how markets allocate, produce, and distribute society's resources. • Predict how government intervention impacts market outcomes. • Critique market outcomes and government policies using concepts of efficiency and equity. • Explain firm behavior under various degrees of competition. • Extend the market framework to analyze market failures. • Critically analyze the positive and negative impacts of markets as they relate to social justice and environmental issues. • Represent and understand economic concepts and outcomes in numerical and graphical form.

Engineering Technology Courses	ENGR 100- Engineering Orientation	This course explores engineering and technology through class discussion, hands-on activities, and presentations by guest speakers. Topics include engineering disciplines, degree and transfer options, career opportunities, academic success strategies, and planning your program of study.	Knowledge of the following: 1. Introduction to engineering & what engineers do 2. Engineering & engineering technology disciplines 3. Keys to success in engineering study 4. Engineering careers & salaries 5. The engineering process (design, teamwork, and communication) 6. Program of study planning 7. Transfer schools and their requirements	• Define engineering/engineering technology and identify the engineering disciplines. • Develop a "program of study" coursework plan to guide them if they choose to pursue engineering as a major. • Determine the particular coursework required for admittance to the transfer institution(s) of their choice if they plan to transfer. • Identify potential career options and salaries. • Recognize the role of teamwork, communication, and design in engineering. • Effectively use academic success strategies throughout the course of their engineering education.
	ENGR& 104- Introduction to Engineering & Design	Course explores the role of teamwork, creativity, and communication in innovative engineering design. Topics include engineering design process, collaborative problem solving techniques, and computer applications. Students will develop their knowledge and skills in these areas through a series of hands-on design projects.	The goal of this course is to expose students to the engineering design process and basic engineering problem solving through hands-on design projects. Students will also become familiar with the interpersonal and computerized tools commonly used in the engineering design process.	• Stimulate innovation and creativity in themselves and others. • Identify and exercise the creative problem solving process. • Demonstrate techniques of effective documentation. • Function as an effective team player. • Communicate complex ideas to their peers. • Utilize basic math and engineering skills for solving open-ended design problems. • Identify unit systems and complete unit conversions.
	ENGR 115- Graphics	An introduction to engineering drawing and graphics technology. Topics include sketching, three-dimensional visualization, displaying solid objects in two-dimensional views, dimensioning, methods for improving visualization skills, and reading engineering drawings.	To utilize freehand sketching techniques to develop visualization skills and as an instrument for design conceptualization and communication. To utilize sketching techniques to create isometric and multi-view drawings of simple parts according to ANSI standards.	• Demonstrate fluency in visual communication. • Create isometric sketches of three dimensional objects. • Create multi-view, two-dimensional sketches of three dimensional objects. • Gain experience getting from concept to visual representation of 3D objects. • Effectively read and understand technical engineering drawings • Fully dimension a drawings according to ANSI standards.

	CENG 101: Energy & Society	Modern society is completely dependent on vast amounts of cheap energy, but the costs are high. Will we have enough usable energy for a planet of nine billion people? How do our choices in energy production impact the global and local environment? We will address these and other questions surrounding human energy use and wok to understand the science, technology, and policy of energy use in the 21st century.	The goal of this course is to introduce the student to the field of renewable energy and to provide an understanding of the relationship between energy production and the societal use of energy.	• Define personal energy use and describe how energy use pervades daily life • Explain how thermodynamics applies to energy. • Describe the societal use of energy across three principle sectors: transportation, industrial, consumer. • Identify and describe the economic cost and environmental consequence of energy use. • Evaluate the transition from a fossil fuel based society to renewable energy based society in terms of time and resources.
	CENG 201: Energy Politics and Policy	This course will allow students to understand the history of energy policy within the US; gain an understanding of the major actors in energy policy; and explore the implications for energy policy from local to global levels. A specific focus will be placed on energy issues as they pertain to the Pacific Northwest.	The goal of this course is to provide students with an understanding of the link between energy policy and politics.	• Outline the vocabulary of energy (measurement, transformation, storage, power, policy etc.). • Characterize the potential benefits and risks of different energy technologies. • Write a policy brief. • Use concept mapping software to characterize a policy discussion. • Describe how key emerging energy technologies operate. • Explain the general benefits and risks of specific energy technologies. • Discuss what is involved in making policy about controversial technology in a democratic society. • Describe how policy is used to inform decisions and how social justice is enhanced or harmed by energy policy.
	CENG 220: Energy Generation and Conservation	This course introduces the engineering and technical aspects of renewable energy systems. It emphasizes basic generation and conservation technologies of renewable energy generation systems. Topics include heat transfer, power, thermodynamics, energy storage, energy conversion.	The aim of this course is to provide the students with a strong understanding of the underlying science behind the generation, transformation and utilization of energy resources.	• Discuss and compare different energy generation technologies, their advantages and disadvantages • Formulate and evaluate simple calculations related to energy, work, power, force, conservation of energy, heat transfer (conduction, convection and radiation) and energy storage. • Evaluate and analyze different energy generation technologies related to renewable energy systems. • Critically analyze a system in terms of energy conservation and generation.

	ENET 100: Direct Current	An introduction to the fundamental properties and applications of electricity. This course covers the basic principles of DC electronics such as; voltage, current and resistance, Ohm's law, Joule's law, Kirchhoff's voltage and current laws, passive devices included resistors, capacitors, and inductors, circuit applications included maximum power transfer, superposition, Thevenin and Norton theorems. An introduction to magnetism which covers; magnetic fields, flux, density, permeability, retentivity, reluctance, and hysteresis. Students also learn how solder and understand the lab safety protocol.	The goal of this course is to give the student an introduction to DC circuits and their applications.	• Demonstrate the knowledge of the following laws: Ohm, Joule, Kirchhoff voltage and current. • Identify passive components such as: resistors and inductors color coding and the capacitors with their values. • Construct and measure voltage and current with difference configuration such as: series, parallel, series and parallel combinational circuits. • Troubleshoot and isolate fault within the circuits with extra loading and applying the maximum power transfer and supposition theorems. • Construct and measure the voltage and current behavior for passive components with, resistor, capacitor and inductor circuits and analyze it characteristics.
	ENET 120: Alternating Current	An introduction and examination of the principles and applications of alternating current. Topics include period, frequency, phase angle, reactance, impedance, resonance, peak and rms values, resistive, apparent, reactance power, and power factor. Students continue their exploration of AC with transformers and filter circuits (low-pass, high-pass, band-stop and band-pass). Practical labs and project help the students understand circuit constructions and troubleshooting techniques.	The goal of this course is to give the student an introduction to AC circuits and their applications.	• Demonstrate the knowledge to differentiate the AC wave form in terms of: period, frequency, voltage peak-to-peak, average and RMS values, • Vector analysis in series, parallel and series-parallel configurations using resistance, reactance, impedance and phase angle components. • Power analysis and compensation using, real, reactive, and apparent power components and to calculate the power factor • Construct and measure a low-pass, high-pass, band-pass and band-stop filter and identify its cutoff frequencies. • Identify the difference between a motor, generator, AC inductor and AC synchronous motor. • Design, build and debug a single or dual AC to DC power supply unit.

	ENET 130: Semi-Conductors	This course introduces semiconductor discrete components such as; diodes, bipolar transistors, FETS, MOSFET, SCR, diacs, triacs, and UJT. Circuit applications include; switching, amplifiers, oscillators, and power supply circuits. Practical labs and project help the students understand circuit constructions and troubleshooting techniques.	The goal of this course is to give the student an introduction to semi conductor components and their applications.	• Demonstrate the knowledge of the construction of a semi-conduction device using pn-junctions such as: diode, npn and pnp transistors. • Demonstrate the knowledge to differentiate the semi-conductor family such as: BJT, JET, JET, IGFET, MOSFET and thyristor devices. • Construct and measure voltage and current of some of semi-conductor devices applications. • Troubleshoot and isolate fault using vendor specifications to apply to individual circuit design. • Design and analyze transistor amplifier configuratior in tern of: Class A, AB and C • Analyze and measure different oscillator configurations such as: Colpitts, Wien bridge and Harley. • Design, build and debug a three stage amplifier that provides a gain of 300 without output distortion.
	ENET 140: Operational Amplifier	This course introduces the basic concepts of an operational amplifiers. Topics include different configurations such as; comparator, differential amplifier, open and close loop feedback, CMR and CMRR, inverting and non-inverting, voltage/current converter, summer circuit, instrumentation amplifier, precision rectifier, and active filters. Practical labs and project help the students understand circuit constructions and troubleshooting techniques.	The goal of this course is to give the student an introduction operational amplifiers and their applications.	• Demonstrate the knowledge of the construction of an operation amplifier within the three stages such as: differential input, linear amplification and power outpu • Demonstrate the knowledge to Op-Amp configurations such as: common mode, differential mode and commor mode rejection ratio. • Construct and measure voltage and current Op-Amp applications such as: comparator, inverted or non-inverted input, summer, differential and instrumentatic amplifier circuits. • Apply transfer functions to calculate the gain of any system configurations. • Troubleshoot and isolate fault using vendor specifications to apply to individual circuit design. • Analyze and measure active filter design using Op-Amp components. • Design, build and debug an amplifier with volume contr using Op-Amp and feedback mechanism

	ENET 150: Digital	This course introduces basic concepts of logic operations, circuit and functions. Topics include; number systems, digital codes and parity, logic gates, Boolean algebra, Karnaugh map, function of combinational logic, flip-flop, counters, adders, and memory devices. Practical labs and project help the students understand digital circuits and troubleshooting techniques.	The goal of this course is to give the student an introduction to digital circuits and their applications.	• Demonstrate the knowledge of number system with differenc bases such as: decimal, binary, octal and hexadecimal • Construct and map truth table the following common logic gates: Or, AND, NOR, AND, EXCLUSIVE OR and NOR, and INVERTER. • Demonstrate the knowledge of applying Booleans algebra, Karnaugh map, DeMorgan theorem, MAX and MIN term such as SOP and POS to simplify logic expressions. • Construct and measure voltage related to logical states circuit such as: S-R and J-K flip-flops, half and full adder, timing diagrams for sequential, combinational and decoder logics. • Apply transfer functions to calculate the gain of any system configurations. • Troubleshoot and isolate fault using truth table to determine the logical HIIGH and LOW states. • Analyze and measure counters, shift registers and flip-flops with vendor's specific to determine the devices are fully functional. • Design, build and debug a digital clock with 3 display (second, minute, and hour)
	ENET 264: Emerging Technology	This course is designed to keep students current with technology. Currently this course is an introduction to solar technology, nano-technology, and fuel cell (PEM) technologies. Students will learn the characteristics and the efficiency of the PV solar cell and PME fuel cell. Emphasis on clean energies and application. This course will change as new emerging technologies move to the forefront. Practical labs and project help the students to put theories into action and learn troubleshooting techniques.	The goal of this course is to give the student an introduction to emerging technologies in electronics and to keep students up to date with industry trends.	• Demonstrate the following construction concepts of: PV solar cell and PEM fuel cells. • Construct and measure the efficiencies of the PV solar cell. • Analyze and measure different parameters of the fuel cells. • Demonstrate the basic concept of nano applications in medicine, and engineering. • Design build and debug a remote solar vehicle and determine the power and efficiencies.