Energy, Power, and Transportation Technology 11

Unifying Concepts

By the end of the course, students will be expected to demonstrate an understanding of energy, power, and transportation technology.

Students will be expected to

A. demonstrate an understanding of the function of energy, power, and transportation in historical contexts and modern society
B. demonstrate an understanding of the basic technology system and its application in energy, power, and transportation
C. analyze, critique, and evaluate the application and outputs of a variety of methods used in energy, power, and transportation technology and the design process in satisfying needs and wants
D. demonstrate an understanding of the requirements for careers in energy, power, and transportation

Specific Curriculum Outcomes

Students will be expected to

Unit 1: Electricity and Electronics

1.1 explain electricity in terms of the behaviour and control of electrons
1.2 define voltage, amperage, and resistance in terms of electrons and recognize series circuits, parallel circuits, and series parallel circuits
1.3 identify and verify series and parallel circuit operation
1.4 identify and apply the fundamentals of Ohm's law
1.5 distinguish between analog and digital devices and circuits
1.6 recognize and name the basic components used in electronics
1.7 identify the schematic symbols of electronic components, understand and follow electronic and schematic diagrams
1.8 recognize and demonstrate the effects of capacitance and inductance in a DC circuit and an AC circuit
1.9 explain and give examples of the properties of permanent magnetism and electro-magnetism
1.10 explain the characteristics of AC current and voltage
1.11 recognize and identify the characteristics of semi-conductors and properties of PN junctions
1.12 explain and test the device parameters of diodes and transistors
1.13 identify integrated circuit logic memory
1.14 explain logic gates, how they are constructed, and how they work
1.15 combine logic gates to build complex digital devices like clocks, flip flops, and timers
1.16 apply and display the principles of Boolean algebra to digital circuits
1.17 calculate amperage and wattage according to Ohm's law and Watt's law
1.18 define and demonstrate voltage drop in simple circuits, and explain the difference between direct and alternating current

1.19 distinguish and use electronic components, such as diodes, transistors, integrated circuits, and microprocessors
1.20 list and apply general safety rules procedures in the study of energy, power, and transportation
1.21 identify, manipulate, and use the basic controls of an oscilloscope, and set up and display various electrical wave forms
1.22 calculate and test unknown voltage current resistance or power in a simple circuit using Ohms law
1.23 connect, evaluate, and troubleshoot linear integrated circuits
1.24 connect, evaluate, and troubleshoot digital integrated circuits subsystems
1.25 breadboard/simulate, operate, test, and troubleshoot various electronic circuits
1.26 employ electronic components to control electric current (e.g., resistor and LED
1.27 employ switching devices that use small amounts of energy to control much larger amounts of energy (e.g., relays)
1.28 operate test equipment to find faults in circuits (e.g., resistance, metre, multimeter, and continuity tester)

Unit 2: Robotics and Automation

2.1 describe the basic feature of a robot for both low and high technology applications such as axis manipulators, actuators, controllers
2.2 describe the use of electric and fluid power systems as used in robotics
2.3 describe the operation of a microcomputer and list the major developments in the evolution of the computer and its application in an automated control system
2.4 identify the use of robots in modern industries and discuss their social and economic impact
2.5 explain what is meant by an automated control system and demonstrate the three separate functions: sensing, control, and operating

Unit 3: Mechanics

3.1 compare and contrast different types of engines, including their historical development under the following categories: internal, external, intermittent, continuous, reciprocating, rotary and describe the working principles of at least one engine in each category
3.2 name five applications of small engines and describe design variables used in small gas engines
3.3 describe how jet engines operate, and explain the operation of two types of rocket engines used in the space exploration programs
3.4 analyze the technologies used to change power to different torques and/or horsepower, and relate how power is controlled in a mechanical energy system
3.5 define transportation technology and describe the importance of the four major categories listed as terrestrial, marine, atmospheric, and space
3.6 identify different types of land transportation systems and the need for them, including bus, truck, automobile, and rail
3.7 describe the two major categories of marine systems inland and ocean and provide examples of the variety of modes used
3.8 state the economic and social impact of air transportation and its value to society and the supporting agencies
3.9 list the basic aviation principles dealing with aerodynamics, and identify the important parts of an aircraft
3.10 describe and demonstrate the purpose and operation of small engine systems, including ignition, cooling, fuel, lubrication, starting, and exhaust systems

3.11 identify and perform various service procedures and trouble-shooting tasks used on small gasoline engines
3.12 describe and illustrate the differences between the operation of two- and four-cycle engines of both gasoline and diesel variety
3.13 explain and illustrate, in graphic form, the operation of several continuous combustion engines, including the Sterling, gas turbine, and steam turbine
3.14 distinguish and demonstrate at least three ways of transmitting power to machines, and solve problems involving simple machines to effect mechanical advantage
3.15 demonstrate how gears, pulleys and belts, sprockets and chains, clutches, and couplings are used to control and/or change the direction of power

Unit 4: Nature and Sources of Energy

4.1 say where fossil fuel resources are located in Nova Scotia and identify different types of characteristics
4.2 define how petroleum exploration takes place and describe how it is produced and transported
4.3 summarize the characteristics and describe the refining of natural gas and detail how it is distributed in Canada
4.4 identify the six major forms of energy, and state the meaning of the laws of energy conservation
4.5 define energy, explain how it is able to produce motion, heat, and light, and recount the terms used to measure energy
4.6 pinpoint the energy source in different products that are being produced
4.7 explain the terms work, energy, power, and foot pounds and state the use of the formulas for work efficiency, power, and horsepower, and the difference between kinetic and potential energy
4.8 specify the extent to which nuclear energy is used in Canada, and define nuclear fusion
4.9 describe how energy originates and explain how it is converted into controlled forms used in residential, industry, business, and transportation situations
4.10 recognize several principles of solar-derived energy, and define differences between active and passive solar technology
4.11 explain how heat is moved by conduction, radiation, and convection and demonstrate the application of this knowledge
4.12 outline the operation of a solar collector, and specify some residential uses of solar energy
4.13 relate the operation and use of solar photovoltaic cells
4.14 identify the different forms of technology used to generate wind energy and describe the inherent potential and problems
4.15 distinguish the four different types of biomass and summarize how biomass can be used as an energy resource (especially wood)
4.16 discuss the importance of hydroelectric energy and identify and describe one example in Nova Scotia
4.17 relate the application of an alternative source of energy

Unit 5: Power Generation, Transfer, Control, and Conservation

5.1 describe how Nova Scotians produce power from the three basic energy source groups
5.2 describe and provide examples of energy conversion for the purpose of moving energy to where it is needed and delivering it in a form appropriate to the need
5.3 explain how to apply the basic elements of control to various energy or power forms stop, start, amplify, efficiency, containment, and direction

5.4 describe the operation of hydraulic and pneumatic fluid power systems, and explain fluid power principles, including force pressure and mechanical advantage
5.5 define various fluid characteristics, including viscosity, pour point, and types of additives, and compare and contrast the advantages and disadvantages of using synthetic fluids in fluid power systems
5.6 realize the importance of lubrication in reducing energy losses
5.7 realize in products that parts can move in relation to one another and that such systems are called mechanisms
5.8 use calculations to predict the operation and effectiveness of mechanisms
5.9 associate that control systems have inputs processes and outputs and locate these in products
5.10 understand that sensitivity and lag are important in control systems
5.11 specify boundaries within a control system to clarify where the system to be controlled begins and ends
5.12 identify within the construction of a product the difference between an open and closed loop system and the importance of feedback and achieving control
5.13 pinpoint and record the control functions of various parts of a system that have been produced
5.14 design and model simple mechanical systems that change the magnitude and motion of an input force in terms of type, axis, or plane
5.15 demonstrate how fluid is used to transfer force and can be used to change the relationship between force distance or speed
5.16 define and apply several terms used to describe power, including work, power, force, torque, and horsepower, and describe how horsepower is measured
5.17 use different sources of energy in products that have been made to control movement in devices that are being made and recognize that control is making things do what is intended
5.18 embody in a product design: levers to augment movement, gears or pulleys to change the speed and direction of rotation, or electric circuits twinned to a power source
5.19 operate and combine simple mechanical components such as linkages, cranks, and gears to achieve different types of movement, e.g., linear, rotary, or oscillating, within a product
5.20 interconnect different systems in a product using solenoid or electromechanical interfaces
5.21 employ sensors in switching and digital logic circuits
5.22 use different sized and/or linked syringes to transmit force pneumatically or hydraulically
5.23 apply a range of valves and other control devices and make analogies with switching devices and other systems
5.24 employ mechanisms to achieve movement in more than one plane
5.25 use single-acting cylinders in three port valves in basic pneumatic systems
5.26 actuate mechanisms to achieve movement in more than one plane
5.27 employ microelectronic devices to control pneumatic, hydraulic, or mechanical systems

Unit 6: Environmental Impact of Energy, Power, and Transportation

6.1 explain the coal mining process and appreciate the possible negative and positive impacts on society and the environment
6.2 express the major principles of how to conserve energy in any system, including heat loss, gain, and other thermal properties
6.3 provide examples of methods used to save energy in the commercial and residential sectors of society, and identify the use of several energy-saving appliances
6.4 specify and communicate several ways to save energy in the transportation sector of society
6.5 observe how the use of power contributes to pollution, and list the major sources of pollution
6.6 discuss the role of government in controlling pollution, and explain the importance of recycling

6.7 discern and describe the possible technologies that may evolve in the future in the area of energy, power, and transportation
6.8 recognize the need and purpose for space transportation programs

Unit 7: Future Trends and Careers

7.1 outline and describe current and potential careers in transportation and power technology
7.2 explain the role of research and development in gaining new knowledge and solutions to problems in the realm of energy, power, and transportation
7.3 summarize how an understanding of their personal abilities, interests, and values is important in making a career choice