Wyoming Department of Education Required Virtual Education Course Syllabus

Niobrara County School District # 1

Program Name	Wyoming Virtual Academy	Content Area	VE
Course ID	D-OTH-211V1-CEN	Grade Level	9-12
Course Name	CEN Introduction to Mechanical Engineering	# of Credits	0.5
SCED Code	21015G0.5011	Curriculum Type	K12 Inc

COURSE DESCRIPTION

This course introduces students to the field of mechanical engineering and helps them develop an appreciation for how engineers design hardware that builds and improves societies around the world. The course covers topics such as technical problem-solving skills, design, engineering analysis, and modern technology to provide a solid mechanical engineering foundation students need for future success in the field.

WYOMING CONTENT AND PERFORMANCE STANDARDS

STANDARD#	BENCHMARK_(Standard/Indicator) Use the Standards and Benchmarks as Spreadsheets
CV12.2.1	College and career-ready students communicate clearly, effectively, and with reason.
CV12.2.2	College and career-ready students identify and model integrity, ethical leadership and effective management skills.
CV12.2.4	College and career-ready students apply safe, legal, and responsible use of information and technology as appropriate to the task.
CV12.3.1	College and career-ready students identify and define authentic problems and significant questions for investigation.
CV12.3.2	College and career-ready students identify trends, forecast possibilities, and explore complex systems and issues.
CV12.3.3	College and career-ready students employ valid and reliable research strategies and apply prior knowledge to solve a problem or complete a project.
CV12.4.1	College and career-ready students produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (*CCSS W.11.4)
CV12.4.2	College and career-ready students determine the meaning of symbols, key terms, and other content-specific words and phrases as they are used in technical context. (*Adapted from CCSS RL.9.11)
CV12.4.3	College and career-ready students acquire, manipulate, analyze, diagnose, and/or report information, using the appropriate technology.
CV12.4.4	College and career-ready students precisely follow a complex multistep procedure when performing technical tasks. (*Adapted from CCSS RL.9.3)
CV12.5.1	College and career-ready students manage resources to develop, analyze, and implement systems and applications.

CV12.5.2	College and career-ready students productively complete tasks taking constraints, priorities and resources into account.
CV12.5.3	College and career-ready students safely and ethically use current industry-standard tools and emerging technologies.

SCOPE AND SEQUENCE		
UNIT OUTLINE	STANDARD#	OUTCOMES OBJECTIVES/STUDENT CENTERED GOALS
Unit 1: The Mechanical Engineering Profession	CV12.2.1 CV12.3.1 CV12.4.1	• 1-1 Describe some of the differences among engineers, mathematicians, and scientists. • 1-2 Discuss the type of work that mechanical engineers do, list some of the technical issues they address, and identify the impact that they have in solving global, social, environmental, and economic problems. • 1-3 Identify some of the industries and governmental agencies that employ mechanical engineers. • 1-4 List some of the products, processes, and hardware that mechanical engineers design. • 1-5 Recognize how the mechanical engineering profession's "top ten" list of achievements has advanced our society and improved day-to-day lives. • 1-6 Understand the objectives and format of a typical curriculum for mechanical engineering students.
Unit 2: Mechanical Design	CV12.2.1 CV12.3.1 CV12.4.1	• 2-1 Outline the major steps involved in a mechanical design process. • 2-2 Recognize the importance of mechanical design for solving the technical, global, and environmental challenges that society faces. • 2-3 Recognize the importance of innovation in designing effective engineered products, systems, and processes. • 2-4 Recognize the importance of multidisciplinary teams, collaboration, and technical communication in engineering. • 2-5 Be familiar with some of the processes and machine tools used in manufacturing. • 2-6 Understand how patents are used to protect a newly developed technology in the business side of engineering. • 2-7 Describe the role played by computer-aided engineering tools in linking

		mechanical design, analysis, and manufacturing.
Unit 3: Technical Problem-Solving and Communication Skills	CV12.2.1 CV12.2.2 CV12.2.4 CV12.3.1 CV12.3.2 CV12.3.3 CV12.4.2 CV12.4.3 CV12.4.4 CV12.5.1 CV12.5.2 CV12.5.3	• 3-1 Understand the fundamental process to analyze and solve engineering problems. • 3-2 Report both a numerical value and its unit in each calculation performed. • 3-3 List the base units in the United States Customary System and the Système International d'Unités, and state some of the derived units used in mechanical engineering. • 3-4 Understand the need for proper handling of units when making engineering calculations and the implications of not doing so. • 3-5 Convert numerical quantities between the United States Customary System and the Système International d'Unités. • 3-6 Check your calculations to verify that they are dimensionally consistent. • 3-7 Understand how to perform order-of-magnitude approximations. • 3-8 Recognize why communication skills are important to engineers, and be able to clearly present solutions in written, oral, and graphical forms.
Unit 4: Forces in Structures and Machines	CV12.2.1 CV12.2.2 CV12.2.4 CV12.3.1 CV12.3.2 CV12.3.3 CV12.4.2 CV12.4.3 CV12.4.4 CV12.5.1 CV12.5.2 CV12.5.3	• 4-1 Break a force down into its rectangular and polar components. • 4-2 Determine the resultant of a system of forces by using the vector algebra and polygon methods. • 4-3 Calculate the moment of a force using the perpendicular lever arm and moment component methods. • 4-4 Understand the requirements for equilibrium, and be able to calculate unknown forces in simple structures and machines. • 4-5 From the design standpoint, explain the circumstances in which one type of rolling element bearing would be selected for use over another, and calculate the forces acting on them.
Unit 5: Materials and Stresses	CV12.2.1 CV12.2.2 CV12.2.4	• 5-1 Identify circumstances in which a mechanical component is loaded in tension,

	CV12.3.1 CV12.3.2 CV12.3.3 CV12.4.2 CV12.4.3 CV12.4.4 CV12.5.1 CV12.5.2 CV12.5.3	compression, or shear, and calculate the stress present. • 5-2 Sketch a stress–strain curve, and use it to describe how a material responds to the loads applied to it. • 5-3 Explain the meaning of the material properties known as the elastic modulus and yield strength. • 5-4 Understand the differences between elastic and plastic responses of materials and between their ductile and brittle behaviors. • 5-5 Discuss some of the properties and uses for metals and their alloys, ceramics, polymers, and composite materials. • 5-6 Apply the concept of a factor of safety to the design of mechanical components that are subjected to tension or shear stress.
Unit 6: Fluids Engineering	CV12.2.1 CV12.2.2 CV12.2.4 CV12.3.1 CV12.3.2 CV12.3.3 CV12.4.2 CV12.4.3 CV12.4.4 CV12.5.1 CV12.5.2 CV12.5.3	• 6-1 Recognize the application of fluids engineering to such diverse fields as microfluidics, aerodynamics, sports technology, and medicine. • 6-2 Explain in technical terms the differences between a solid and a fluid, and the physical meanings of a fluid's density and viscosity properties. • 6-3 Understand the characteristics of laminar and turbulent fluid flows. • 6-4 Calculate the dimensionless Reynolds number, which is the most significant numerical value in fluids engineering. • 6-5 Determine the magnitudes of the fluid forces known as buoyancy, drag, and lift in certain applications. • 6-6 Analyze the volumetric flow rate and pressure drop of fluids flowing through pipes.
Unit 7: Thermal and Energy Systems	CV12.2.1 CV12.2.2 CV12.2.4 CV12.3.1 CV12.3.2 CV12.3.3 CV12.4.2 CV12.4.3 CV12.4.4 CV12.5.1 CV12.5.2	• 7-1 Calculate various energy, heat, work, and power quantities that are encountered in mechanical engineering, and express their numerical values in the SI and USCS. • 7-2 Describe how heat is transferred from one location to another by the processes of conduction, convection, and radiation. • 7-3 Apply the principle of energy conservation for a mechanical system.

	CV12.5.3	• 7-4 Explain how heat engines operate and understand the limitations on their efficiency. • 7-5 Outline the basic operating principles behind two-stroke and four-stroke internal-combustion engines and electric power plants.
Unit 8: Motion and Power Transition	CV12.2.1 CV12.2.2 CV12.2.4 CV12.3.1 CV12.3.2 CV12.3.3 CV12.4.2 CV12.4.3 CV12.4.4 CV12.5.1 CV12.5.2 CV12.5.3	• 8-1 Perform calculations involving rotational velocity, work, and power. • 8-2 Discuss the circumstances in which one type of gear would be selected for use over another in terms of design. • 8-3 Explain some of the design characteristics of V-belts and timing belts. • 8-4 In simple and compound geartrains and belt drives, calculate shaft speeds and torques and calculate the amount of power that is transferred in simple and compound greatrains and belt drives. • 8-5 Sketch a planetary geartrain, identify its input and output connection points, and explain how it works.