Texas CTE

Engineering Science

Knowledge and skills. ENGSCI

1 **The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:** ENGSCI.1

- A ask questions and define problems based on observations or information from text, phenomena, models, or investigations; ENGSCI.1A
- B apply scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems; ENGSCI.1B
- C use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards; ENGSCI.1C
- D use appropriate tools such as dial caliper, micrometer, protractor, compass, scale rulers, multimeter, and circuit components; ENGSCI.1D
- E collect quantitative data using the International System of Units (SI) and United States customary units and qualitative data as evidence; ENGSCI.1E
- F organize quantitative and qualitative data using spreadsheets, engineering notebooks, graphs, and charts; ENGSCI.1F
- G develop and use models to represent phenomena, systems, processes, or solutions to engineering problems; and ENGSCI.1G
- H distinguish between scientific hypotheses, theories, and laws. ENGSCI.1H

2 **The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:** ENGSCI.2

- A identify advantages and limitations of models such as their size, scale, properties, and materials; ENGSCI.2A
- B analyze data by identifying significant statistical features, patterns, sources of error, and limitations; ENGSCI.2B
- C use mathematical calculations to assess quantitative relationships in data; and ENGSCI.2C
- D evaluate experimental and engineering designs. ENGSCI.2D

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he student develops evidence-based explanations and communicates findings, onclusions, and proposed solutions. The student is expected to: ENGSCI.3

A develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories; ENGSCI.3A

B communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and ENGSCI.3B

C engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence. ENGSCI.3C

4 The student knows the contributions of scientists and engineers and recognizes the importance of scientific research and innovation on society. The student is expected to: ENGSCI.4

A analyze, evaluate, and critique scientific explanations and solutions by using empirical evidence, logical reasoning, and experimental and observational testing so as to encourage critical thinking by the student; ENGSCI.4A

B relate the impact of past and current research on scientific thought and society, including research methodology, cost-benefit analysis, and contributions of diverse scientists and engineers as related to the content; and ENGSCI.4B

C research and explore resources such as museums, libraries, professional organizations, private companies, online platforms, and mentors employed in a STEM field. ENGSCI.4C

5 The student investigates engineering-related fields and career opportunities. The student is expected to: ENGSCI.5

A differentiate between engineering and engineering technology; ENGSCI.5A

B compare the roles or job descriptions for career opportunities in the fields of pure science, engineering, and engineering technology; ENGSCI.5B

C identify and differentiate between the different engineering disciplines; and ENGSCI.5C

D demonstrate appropriate oral, written, and visual forms of technical communication. ENGSCI.5D

6 The student demonstrates an understanding of design problems and works individually and as a member of a team to solve design problems. The student is expected to: ENGSCI.6

A solve design problems individually and in a team; ENGSCI.6A

B create solutions to existing problems using a design process; ENGSCI.6B

C use a design brief to identify problem specifications and establish project constraints; ENGSCI.6C

D use communication to achieve a desired goal within a team; and ENGSCI.6D

E work as a member of a team to conduct research to develop a knowledge base, stimulate creative ideas, and make informed decisions. ENGSCI.6E

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'he student understands mechanisms, including simple and compound machines, nd performs calculations related to mechanical advantage, drive ratios, work, and power. The student is expected to: ENGSCI.7

A explain the purpose and operation of components, including gears, sprockets, pulley systems, and simple machines; ENGSCI.7A

B explain how components, including gears, sprockets, pulley systems, and simple machines, make up mechanisms; ENGSCI.7B

C distinguish between the six simple machines and their attributes and components; ENGSCI.7C

D measure forces and distances related to a mechanism; ENGSCI.7D

E calculate work and power in mechanical systems; ENGSCI.7E

F determine experimentally the efficiency of mechanical systems; and ENGSCI.7F

G calculate mechanical advantage and drive ratios of mechanisms. ENGSCI.7G

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8 **The student understands energy sources, energy conversion, and circuits and performs calculations related to work and power. The student is expected to:** ENGSCI.8

A identify and categorize energy sources as nonrenewable, renewable, or inexhaustible; ENGSCI.8A

B define and calculate work and power in electrical systems; ENGSCI.8B

C calculate and explain how power in a system converts energy from electrical to mechanical; and ENGSCI.8C

D define voltage, current, and resistance and calculate each quantity in series, parallel, and combination electrical circuits using Ohm's law. ENGSCI.8D

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9 **The student understands system energy requirements and how energy sources can be combined to convert energy into useful forms. The student understands the relationships between material conductivity, resistance, and geometry in order to calculate energy transfer and determine power loss and efficiency. The student is expected to:** ENGSCI.9

A explain the purpose of energy management; ENGSCI.9A

B evaluate system energy requirements in order to select the proper energy source; ENGSCI.9B

C explain and design how multiple energy sources can be combined to convert energy into useful forms; ENGSCI.9C

D describe how hydrogen fuel cells create electricity and heat and how solar cells create electricity; ENGSCI.9D

E measure and analyze how thermal energy is transferred via convection, conduction, and radiation; ENGSCI.9E

F analyze how thermal energy transfer is affected by conduction, thermal resistance values, convection, and radiation; and ENGSCI.9F

G calculate resistance, efficiency, and power transfer in power transmission and distribution applications for various material properties. ENGSCI.9G

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10 **The student understands the interaction of forces acting on a body and performs calculations related to structural design. The student is expected to:** ENGSCI.10

- A illustrate, calculate, and experimentally measure all forces acting upon a given body; ENGSCI.10A
- B locate the centroid of structural members mathematically or experimentally; ENGSCI.10B
- C calculate moment of inertia of structural members; ENGSCI.10C
- D define and calculate static equilibrium; ENGSCI.10D
- E differentiate between scalar and vector quantities; ENGSCI.10E
- F identify properties of a vector, including magnitude and direction; ENGSCI.10F
- G calculate the X and Y components given a vector; ENGSCI.10G
- H calculate moment forces given a specified axis; ENGSCI.10H
- I calculate unknown forces using equations of equilibrium; and ENGSCI.10I
- J calculate external and internal forces in a statically determinate truss using translational and rotational equilibrium equations. ENGSCI.10J

11 **The student understands material properties and the importance of choosing appropriate materials for design. The student is expected to:** ENGSCI.11

- A conduct investigative non-destructive material property tests on selected common household products; ENGSCI.11A
- B calculate and measure the weight, volume, mass, density, and surface area of selected common household products; and ENGSCI.11B
- C identify the manufacturing processes used to create selected common household products. ENGSCI.11C

12 **The student uses material testing to determine a product's function and performance. The student is expected to:** ENGSCI.12

- A use a design process and mathematical formulas to solve and document design problems; ENGSCI.12A
- B obtain measurements of material samples such as length, width, height, and mass; ENGSCI.12B
- C use material testing to determine a product's reliability, safety, and predictability in function; ENGSCI.12C
- D identify and calculate test sample material properties using a stress-strain curve; and ENGSCI.12D
- E identify and compare measurements and calculations of sample material properties such as elastic range, proportional limit, modulus of elasticity, elastic limit, resilience, yield point, plastic deformation, ultimate strength, failure, and ductility using stress-strain data points. ENGSCI.12E

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13 **The student understands that control systems are designed to provide consentient process control and reliability and uses computer software to create flowcharts and control system operating programs. The student is expected to:** ENGSCI.13

- A create detailed flowcharts using a computer software application; ENGSCI.13A
- B create control system operating programs using computer software; ENGSCI.13B
- C create system control programs that use flowchart logic; ENGSCI.13C
- D select appropriate input and output devices based on the need of a technological system; and ENGSCI.13D
- E judge between open- and closed-loop systems in order to select the most appropriate system for a given technological problem. ENGSCI.13E

14 **The student demonstrates an understanding of fluid power systems and calculates values in a variety of systems. The student is expected to:** ENGSCI.14

- A identify and explain basic components and functions of fluid power devices; ENGSCI.14A
- B differentiate between pneumatic and hydraulic systems and between hydrodynamic and hydrostatic systems; ENGSCI.14B
- C use Pascal's Law to calculate values in a fluid power system; ENGSCI.14C
- D distinguish between gauge pressure and absolute pressure and between temperature and absolute temperature; ENGSCI.14D
- E calculate values in a pneumatic system using the ideal gas laws; and ENGSCI.14E
- F calculate and experiment with flow rate, flow velocity, and mechanical advantage in a hydraulic system model. ENGSCI.14F

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15 **The student demonstrates an understanding of statistics and applies the concepts to real-world engineering design problems. The student is expected to:** ENGSCI.15

- A calculate and test the theoretical probability that an event will occur; ENGSCI.15A
- B calculate the experimental frequency distribution of an event occurring; ENGSCI.15B
- C apply the Bernoulli process to events that only have two distinct possible outcomes; ENGSCI.15C
- D apply AND, OR, and NOT logic to solve complex probability scenarios; ENGSCI.15D
- E apply Bayes's theorem to calculate the probability of multiple events occurring; ENGSCI.15E
- F calculate the central tendencies of a data array, including mean, median, and mode; ENGSCI.15F
- G calculate data variations, including range, standard deviation, and variance; and ENGSCI.15G
- H create and explain a histogram to illustrate frequency distribution. ENGSCI.15H

16 **The student demonstrates an understanding of kinematics in one and two dimensions and applies the concepts to real-world engineering design problems. The student is expected to:** ENGSCI.16

- A calculate distance, displacement, speed, velocity, and acceleration from data; ENGSCI.16A
- B calculate experimentally the acceleration due to gravity given data from a free-fall device; ENGSCI.16B
- C calculate the X and Y components of an object in projectile motion; and ENGSCI.16C
- D determine and test the angle needed to launch a projectile a specific range given the projectile's initial velocity. ENGSCI.16D