

# ENGINEERING CAREER CLUSTER DESIGN

## Cartography/Geospatial/Spatial Mathematics Pathway – CIP Code 15.1102

### Approved Pathway:

- 1) Includes minimum of three secondary-level credits.
- 2) Includes a work-based element.
- 3) Consists of a sequence: Introductory-level, Technical-level, and Application-level courses.
- 4) Supporting documentation includes Articulation Agreement(s), Certification, Program Improvement Plan, and a Program of Study.
- 5) Technical-level and Application-level courses receive .5 state-weighted funding in an approved CTE pathway.

### INTRODUCTORY LEVEL

Earth Science or	03001	1 credit	●Engineering Appl. (8-9)	21002/71002	1 credit
Earth Space Science	53008/03008	1 credit	Φ●Engineering Tech. (8-9)	21003/71003	1 credit
Computing Systems (8-9)	10002/60002	1 credit	ΦPrinciples of Tech. (8-9)	53153/03153	1 credit
Computer Applications (8-9)	10004/60004	1 credit	ΦPre-Engineering Tech (8-9)	21001	1 credit
Physical Geography	03007	1 credit			

### TECHNICAL LEVEL

Meteorology	03006	1 credit	Animation	10210	1 credit
GIS Technology	21058	1 credit	ΦRobotics	21009	1 credit
Aerospace Technology	21055	1 credit			

### APPLICATION LEVEL

GIS Spatial Applications	21112	1 credit	Emerging Technologies in STEM	21053	1 credit
Civil Engineering or	21011	1 credit			
●Civil Eng. & Architecture	21012	1 credit	Project Management		
●Aerospace Engineering	21013	1 credit	and Resource Scheduling	21205	1 credit
Particular Topics in Engineering	21015	1 credit	Workplace Experience	21048	1 credit

●Course appropriate for Project Lead the Way Programs; competencies may be utilized by any/all schools.  
 Φ Course appropriate for Engineering by Design Programs; competencies may be utilized by any/all schools

# KANSAS STATE CAREER CLUSTER COMPETENCY PROFILE

## CARTOGRAPHY/GEOSPATIAL/SPACIAL MATHEMATICS PATHWAY (C.I.P. 15.1102)

STUDENT \_\_\_\_\_  
Rating Scale:

- 3 - Proficient Achievement
- 2 - Limited Achievement
- 1 - Inadequate Achievement
- 0 - No Exposure

## ENGINEERING CLUSTER

Graduation Date \_\_\_\_\_  
I certify that the student has received training in the areas indicated.

Instructor Signature \_\_\_\_\_

Instructor Signature \_\_\_\_\_

Instructor Signature \_\_\_\_\_

Instructor Signature \_\_\_\_\_

### COMMON CAREER TECHNICAL CORE – CAREER READY STANDARDS

1. Act as a responsible and contributing citizen and employee
2. Apply appropriate academic and technical skills
3. Attend to personal health and financial well-being
4. Communicate clearly, effectively and with reason
5. Consider the environmental, social and economic impacts of decisions
6. Demonstrate creativity and innovation
7. Employ valid and reliable research strategies
8. Utilize critical thinking to make sense of problems and persevere in solving them.
9. Model integrity, ethical leadership and effective management
10. Plan education and career path aligned to personal goals
11. Use technology to enhance productivity
12. Work productively in teams while

using cultural/global competence

### COMMON CAREER TECHNICAL CORE – STEM CLUSTER STANDARDS

1. Apply engineering skills in a project that requires project management, process control and quality assurance.
2. Use technology to acquire, manipulate, analyze and report data.
3. Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.
4. Understand the nature and scope of the Science, Technology, Engineering & Mathematics Career Cluster and the role of STEM in society and the economy.
5. Demonstrate an understanding of the breadth of career opportunities and means to those opportunities in each of the Science, Technology, Engineering & Mathematics Career Pathways.
6. Demonstrate technical skills needed in a chosen STEM field.

### INTRODUCTORY LEVEL COURSES

#### 03153 Principles of Technology

- 3 2 1 0
1. The student works safely with mechanical, fluid, electrical, and thermal technology.
    - a. Student will master relevant safety tests
    - b. Student will follow safety manuals, instructions, and requirements
    - c. Student will make prudent choices in the conservation and use of resources and the disposal of materials
    - d. Student will appropriately utilize laboratory equipment to accomplish activities of lesson
    - e. Student will know the location of the MSDS utilized in the work environment
  - 3 2 1 0 2. The student uses a systems approach to investigate mechanical, fluid, electrical, and thermal systems.
    - a. Student will apply the universal

- systems model to technological activities; and
- b. Student will identify the inputs, processes, outputs, and feedback associated with each of the systems.
- 3 2 1 0 3. The student knows the laws governing motion.
- a. Student will analyze examples of uniform and accelerated motion, including linear, projectile, and circular motion;
- b. Student will generate and interpret graphs describing motion, including the use of real time technology;
- c. Student will formulate the effects of forces on the motion of objects;
- d. Student will develop and interpret a free-body diagram for force analysis; and
- e. Student will identify and describe motion related to different frames of reference.
- 3 2 1 0 4. The student knows the concept of force.
- a. Student will apply examples complex technological devices where force must be controlled, measured or applied;
- b. Student will analyze the relationship among force, pressure, voltage, and temperature;
- c. Student will evaluate and predict what happens to an object when forces on it are balanced and when forces on it are unbalanced; and
- d. Student will measure force in mechanical, fluid, electrical, and thermal systems.
- 3 2 1 0 5. The student knows the concept of work.
- a. Student will relate mechanical, fluid, and electrical to force and movement; and
- b. Student will identify and measure the effects of work done in mechanical, fluid and electrical systems.
- 3 2 1 0 6. The student knows the concept of rate.
- a. Student will analyze rate in mechanical, fluid, electrical, and thermal systems; and
- b. Student will measure, verify, and analyze rate in mechanical, fluid, electrical, and thermal systems.
- 3 2 1 0 7. Student knows electrical systems concepts.
- a. Student will identify and recreate basic series and parallel circuits
- b. Students will appropriately utilize symbols on blueprints and charts related to electrical systems
- c. Students will identify and utilize various measures used in electrical systems and the associated tools
- 3 2 1 0 8. The student knows the concept of resistance.
- a. Student will identify resistance in mechanical, fluid, electrical, and thermal energy systems
- b. Student will relate the principle of force divided by rate to resistance in each energy system
- c. Student will measure, verify, and analyze resistance in mechanical, fluid, electrical, and thermal energy systems.
- 3 2 1 0 9. The student knows the concept of energy.
- a. Student will identify the nature of energy;
- b. Student will relate potential energy, kinetic energy, and heat energy to the conservation of energy;
- c. Student will distinguish between work and energy;
- d. Student will measure, verify, and analyze energy in each system; and
- e. Student will evaluate different methods of energy transfer that result in an increasing amount of disorder.
- 3 2 1 0 10. The student knows the concept of power.
- a. Student will define power in mechanical, fluid, electrical, and thermal systems; and
- b. Student will relate the principle of work divided by time to each energy system.
- 3 2 1 0 11. The student knows the concept of energy transformation.
- a. Student will observe and describe examples of kinetic and potential energy in mechanical, fluid, and electrical systems
- b. Student will compare examples of energy transformations in mechanical, fluid, and electrical systems.

- 3 2 1 0 12. Students will work collaboratively with team members to complete an engineering project.

## 21001 Pre-Engineering Technology

### Students will:

#### Communication and interpretation of information in industry-standard formats:

- 3 2 1 0 1. Understand the classification and use of various components, symbols, abbreviations, and media common to electronic and mechanical drawings.
- 3 2 1 0 2. Understand, organize, and complete an assembly drawing by using information collected from detailed drawings.
- 3 2 1 0 3. Know the current industry standards for illustration and layout.
- 3 2 1 0 4. Draw flat layouts of a variety of objects by using the correct drafting tools, techniques, and media
- 3 2 1 0 5. Prepare reports and data sheets for writing specifications.

#### Concepts of physics fundamental to engineering technology:

- 3 2 1 0 6. Understand Newton's laws and how they affect and define the movement of objects.
- 3 2 1 0 7. Understand how the laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.
- 3 2 1 0 8. Analyze the fundamentals and properties of waveforms and how waveforms may be used to carry energy.

- 3 2 1 0 9. Understand how electric and magnetic phenomena are related and know common practical applications.

#### Fundamentals of electrical energy:

- 3 2 1 0 10. Analyze relationships between voltage, current, resistance, and power related to direct current (DC) circuits.
- 3 2 1 0 11. Understand the characteristics of alternating current (AC) and how it is generated; the characteristics of the sine wave; the basic characteristics of AC circuits, tuned circuits, and resonant circuits; and the nature of the frequency spectrum.
- 3 2 1 0 12. Calculate, construct, measure, and employ both AC and DC circuits.
- 3 2 1 0 13. Use appropriate electronic instruments to analyze, repair, or measure electrical and electronic systems, circuits, or components.
- 3 2 1 0 14. Analyze and predict the effects of circuit conditions on the basis of measurements and calculations of voltage, current, resistance, and power.
- 3 2 1 0 15. Classify and use various electrical components, symbols, abbreviations, media, and standards of electrical drawings.
- 3 2 1 0 16. Understand how electrical control and protection devices are used in electrical systems.
- 3 2 1 0 17. Calculate loads, currents, and circuit-operating parameters.

#### Principles of force, work, rate, power, energy, and resistance in mechanical, electrical, fluid, and thermal engineering systems:

- 3 2 1 0 18. Understand scalars and vectors.
- 3 2 1 0 19. Solve problems by using the concept of vectoring to predict the resultant forces.
- 3 2 1 0 20. Know the six simple machines and their applications.
- 3 2 1 0 21. Know how energy is transferred; know the effects of resistance in mechanical, electrical, fluid, and thermal systems.
- 3 2 1 0 22. Solve problems by using the appropriate units applied in mechanical, electrical, fluid, and thermal engineering systems.

#### Utilizing the design process to analyze and solve design problems:

- 3 2 1 0 23. Understand the steps in the design process.
- 3 2 1 0 24. Determine what information and principles are relevant to a problem and its analysis.
- 3 2 1 0 25. Choose between alternate solutions in solving a problem and be able to justify the choices made in determining a solution.
- 3 2 1 0 26. Translate word problems into mathematical statements when appropriate.
- 3 2 1 0 27. Develop a solution from multiple details provided by client.
- 3 2 1 0 28. Build a prototype from plans and test it.
- 3 2 1 0 29. Evaluate and redesign a prototype on the basis of collected test data.

#### Industrial engineering processes, the use of tools and equipment, methods of measurement, and quality assurance:

- 3 2 1 0 30. Know the common structure and processes of a quality assurance cycle.
- 3 2 1 0 31. Understand the major

- manufacturing processes.
- 3 2 1 0 32. Use tools, fasteners, and joining systems employed in selected engineering processes.
- 3 2 1 0 33. Estimate and measure the size of objects in both Standard International and United States units.
- 3 2 1 0 34. Calibrate and measure objects by using precision measurement tools and instruments.

**Computer systems and engineering perspective:**

- 3 2 1 0 35. Understand how to design systems that use computer programs to interact with hardware.
- 3 2 1 0 36. Know the function and interaction of basic computer components and peripherals.
- 3 2 1 0 37. Install and configure computer hardware and software components required for solution.
- 3 2 1 0 38. Understand the relationship among computer hardware, networks, and operating systems.
- 3 2 1 0 39. Understand the process of testing and troubleshooting computer equipment and systems.
- 3 2 1 0 40. Test and maintain wireless and wired communications components and systems.
- 3 2 1 0 41. Use utility software efficiently to diagnose and correct problems.

**Students understand fundamental automation modules and are able to develop systems that complete preprogrammed tasks:**

- 3 2 1 0 42. Use appropriate tools and technology to perform tests, collect data, analyze relationships, and display data in a simulated or modeled automated system.

- 3 2 1 0 43. Understand the use of sensors for data collection and process correction in an automated system.
- 3 2 1 0 44. Program a computing device to control an automated system or process.
- 3 2 1 0 45. Use motors, solenoids, and similar devices as output mechanisms in automated systems.
- 3 2 1 0 46. Assemble input, processing, and output devices to create an automated system capable of accurately completing a preprogrammed task.

**Fundamentals of systems and products in phases of development, production, and marketing:**

- 3 2 1 0 47. Understand the process of product development.
- 3 2 1 0 48. Understand project management, charting, and the use of graphic tools in illustrating the development of a product and the processes involved.

## 21002 Engineering Applications

**Design and Modeling**

- 3 2 1 0 1. Explain the relationship between science, technology, engineering and math.
- 3 2 1 0 2. Describe engineering and explain how engineers participate in or contribute to the invention and innovation of products.
- 3 2 1 0 3. Describe impacts that technology has had on society.
- 3 2 1 0 4. Distinguish between invention and innovation.
- 3 2 1 0 5. Assemble an engineering notebook and a portfolio.

- 3 2 1 0 6. Describe the design process and how it is used to aid in problem solving.
- 3 2 1 0 7. Use the design process to solve a technical problem.
- 3 2 1 0 8. Recognize design criteria and constraints.
- 3 2 1 0 9. Describe the purpose and importance of working in a team.
- 3 2 1 0 10. Explain a design brief and apply the concept when using the design process.
- 3 2 1 0 11. Describe the elements of design and apply this concept to the design process.
- 3 2 1 0 12. Use a decision matrix to select the best solution to a design problem.
- 3 2 1 0 13. Demonstrate the ability to measure accurately with different devices and scales.
- 3 2 1 0 14. Explain how to measure in different contexts.
- 3 2 1 0 15. Measure using both the English and Metric systems.
- 3 2 1 0 16. Summarize the reasoning for using sketching as a communication tool.
- 3 2 1 0 17. Use visualization, spatial reasoning, and geometric shapes to sketch two and three dimensional shapes.
- 3 2 1 0 18. Recognize and create thumbnail, perspective, isometric, and orthographic sketches.
- 3 2 1 0 19. Recognize and accurately interpret one and two-point perspective drawings.
- 3 2 1 0 20. Communicate ideas for a design using various sketching methods, notes, and drafting views.

**Dimension an orthographic sketch following the guidelines of dimensioning.**

- 3 2 1 0 22. Create a three-dimensional (3D) model of an object.
- 3 2 1 0 23. Apply geometric and dimension constraints to design CAD-modeled parts.
- 3 2 1 0 24. Assemble the product using the CAD modeling program.
- 3 2 1 0 25. Demonstrate the ability to produce various annotated working drawings of a 3D model.
- 3 2 1 0 26. Identify the difference between a prototype, a model and a mock-up and analyze what circumstances call for the use of each.
- 3 2 1 0 27. Explain why teams of people are used to solve problems.
- 3 2 1 0 28. Brainstorm and sketch possible solutions to an existing design problem.
- 3 2 1 0 29. Create a decision-making matrix.
- 3 2 1 0 30. Select an approach that meets or satisfies the constraints given in a design brief.

**Automation and Robotics**

- 3 2 1 0 31. Describe the purpose of automation and robotics and its effect on society.
- 3 2 1 0 32. Summarize ways that robots are used in today's world and the impact of their use on society.
- 3 2 1 0 33. Describe positive and negative effects of automation and robotics on humans in terms of safety and economics.

- 3 2 1 0 34. Investigate a career related to automation and robotics and determine the requirements for entering the field.
- 3 2 1 0 35. Investigate and understand various mechanisms to determine their purpose and applications.
- 3 2 1 0 36. Be able to apply their knowledge of mechanisms to solve a unique problem.
- 3 2 1 0 37. Design, build, wire, and program both open and closed loop systems.
- 3 2 1 0 38. Troubleshoot a malfunctioning system using a methodical approach.
- 3 2 1 0 39. Experience fluid power by creating and troubleshooting a pneumatic device.
- 3 2 1 0 40. Design, build, wire and program a system operated by alternative energy.

**Energy and the Environment (optional/extension)**

- 3 2 1 0 41. Differentiate between potential and kinetic energy.
- 3 2 1 0 42. Explain the differences, advantages, and disadvantages between exhaustible, inexhaustible, renewable, and non-renewable energy sources.

**Specific curriculum will differ from program to program. Additional topics of study can include:**

- Efficiency vs. Conservation and measures to address each
- Water Conservation and Management
- Energy Budget and Fiscal Impact
- Geographic Barriers and Availability Considerations of Resources
- Power, Work, and Measure of Energy

- Trends of Consumption of Various Energy Sources
- Environmental Impact of Energy Usage and Disposal

**21003 Engineering Technology**

**Flight and Space**

- 3 2 1 0 1. Apply their knowledge of research techniques to investigate the history of an aerospace vehicle.
- 3 2 1 0 2. Experience the flight characteristics of kites, whirly gigs, model airplanes, hot air balloons, and model rockets.
- 3 2 1 0 3. Utilize language arts skills to write a script and create a storyboard for an infomercial promotion of an aerospace vehicle.

- 3 2 1 0 4. Distinguish between the forces of lift, drag, weight, and thrust that affect an object moving through a fluid. Understand the importance of each force.
- 3 2 1 0 5. Examine how center of gravity affects an aerospace vehicle in distributing weight.
- 3 2 1 0 6. Discover how Newton's laws apply to flight and space.
- 3 2 1 0 7. Discover Bernoulli's principle through exploration.
- 3 2 1 0 8. Recognize the tools and purpose of aeronautic design and testing.
- 3 2 1 0 9. Identify the characteristics of an airfoil and how they compare and contrast with the characteristics of wings.
- 3 2 1 0 10. Analyze the features and benefits of different types of wings.
- 3 2 1 0 11. Describe the major parts (fuselage, empennage, high lift devices, wings, undercarriage, propulsion, instruments, and controls) of aircraft and how they can affect the overall balance of an airplane during flight.
- 3 2 1 0 12. Research and design an airfoil and empennage for use in the prototyping of a Styrofoam glider.
- 3 2 1 0 13. Explore the history and development of rocketry, space flight, and living in space.
- 3 2 1 0 14. Discover the basic principles of flight and rocketry.
- 3 2 1 0 15. Investigate how changes in various design characteristics of a rocket

will affect the rocket's performance.

- 3 2 1 0 16. Know that a rocket must overcome the forces of gravity and drag in order to get out of the atmosphere.
- 3 2 1 0 17. Understand that an orbit is the balance of gravity and an object's tendency to follow a straight path.
- 3 2 1 0 18. Use an immersive learning simulation to select optimal components for a lunar robot's engine, power source, tires, body type and sensor system to save stranded astronauts on the moon.
- 3 2 1 0 19. Understand the challenges that engineers face to provide safe travel and optimum living conditions in space.

#### **Science of Technology**

- 3 2 1 0 20. Describe the difference between a chemist and a chemical engineer.
- 3 2 1 0 21. Apply science and engineering skills to make ice cream.
- 3 2 1 0 22. Follow the design process to create an adhesive.
- 3 2 1 0 23. Work with a team to solve an oil spill engineering simulation problem.
- 3 2 1 0 24. Demonstrate an understanding of how small a nanometer is.
- 3 2 1 0 25. Explore how nano-products are used in society today.
- 3 2 1 0 26. Identify tools and processes used to see and manipulate matter at the nanoscale.
- 3 2 1 0 27. Discuss the impact that nanotechnology has on their lives today and will have in the future.

- 3 2 1 0 28. Correctly identify the six simple machines and explain their applications.
- 3 2 1 0 29. Distinguish between the three classes of levers.
- 3 2 1 0 30. Identify a machine as something that helps use energy more efficiently.
- 3 2 1 0 31. Determine mechanical advantage from assembled simple machines.
- 3 2 1 0 32. Be able to compare and contrast kinetic and potential energy.
- 3 2 1 0 33. Predict the relative kinetic energy based on the mass and speed of the object.
- 3 2 1 0 34. Recognize and follow safety rules for using lab tools and machines.
- 3 2 1 0 35. Build, test, and evaluate a model of a design problem.
- 3 2 1 0 36. Analyze a product through testing methods and make modifications to the product.

#### **Magic of Electrons**

- 3 2 1 0 37. Identify the roles of protons, neutrons, and electrons in an atom.
- 3 2 1 0 38. Identify an element based on the atomic number.
- 3 2 1 0 39. Identify metals, metalloids, and non-metals on the periodic table.
- 3 2 1 0 40. Judge whether a material is a conductor, insulator, or semiconductor based upon its number of valence electrons and its position on the periodic table.
- 3 2 1 0 41. Explain how the Law of Charges holds an atom together.
- 3 2 1 0 42. Explain how electrons transfer from one atom to another to create electron flow.

- 3 2 1 0 43. Define current, voltage, and resistance.
- 3 2 1 0 44. Measure voltage and current using a multimeter.
- 3 2 1 0 45. Understand the properties of a magnet.
- 3 2 1 0 46. Build an electromagnet to demonstrate its characteristics and functions.
- 3 2 1 0 47. Build a DC motor to identify the primary parts and demonstrate how it functions.
- 3 2 1 0 48. Build a generator to identify the primary parts and demonstrate how it functions.
- 3 2 1 0 49. Understand the role of an electromagnet in the function of a DC motor and generator.
- 3 2 1 0 50. Compare the characteristics of a basic motor and generator.
- 3 2 1 0 51. Build series, parallel, and combination electrical circuits.
- 3 2 1 0 52. Create circuit diagrams using standardized schematic symbols.
- 3 2 1 0 53. Build and test physical electrical circuits based upon circuit diagrams.
- 3 2 1 0 54. Integrate DC sources, lamps, switches, diodes, light emitting diodes, resistors, and capacitors into electrical circuits to achieve specific functions.
- 3 2 1 0 55. Distinguish between the functions and operations of fixed resistors, variable resistors, and photo resistors.
- 3 2 1 0 56. Determine the value of a fixed resistor based upon the color codes on those resistors.
- 3 2 1 0 57. Measure voltage, current, and resistance using a multimeter.

- 3 2 1 0 58. Mathematically calculate voltage, current, and resistance using Ohm's law.
- 3 2 1 0 59. Create a circuit that uses a transistor as a switch.
- 3 2 1 0 60. Interpret logic scenarios to determine outputs based upon possible conditions within those scenarios.
- 3 2 1 0 61. Distinguish between the functions of NOT, AND, OR, NAND, NOR, and XOR gates.
- 3 2 1 0 62. Create truth tables for logic scenarios and match those gates to truth tables.
- 3 2 1 0 63. Convert binary numbers to Base-10.
- 3 2 1 0 64. Convert ASCII characters to binary.
- 3 2 1 0 65. Create a digital wave form and graph it for a binary sequence.
- 3 2 1 0 66. Communicate using electronic circuit diagrams.
- 3 2 1 0 67. Use transistors as switches to create circuits that function as AND and OR gates.
- 3 2 1 0 68. Determine the logic, sensors, gates, outputs, and other components needed to emulate existing electronic devices that utilize logic.
- 3 2 1 0 69. Design, construct, and test device solutions for emulating common electronic devices that utilize logic.

## 10004-Computer Applications

- 3 2 1 0 1. Personal Information Management
  - b. word usage, spelling, sentence structure, clarity, email
  - c. Demonstrate knowledge of email etiquette.

- d. Send email messages.
  - e. Access email attachments.
  - f. Attach documents to messages.
  - g. Demonstrate knowledge of contamination protection strategies for email.
  - h. Save email messages / attachments.
- 3 2 1 0 2. Research and Internet
- a. Locate information using search engine(s) and Boolean logic.
  - b. Navigate web sites using software functions.
  - c. Select appropriate search procedures and approaches.
  - d. Select search engine(s) to use.
  - e. Access business and technical information using the Internet.
  - f. Access commercial, government, and education resources.
  - g. Evaluate Internet resources (e.g., accuracy of information).
  - h. Explore browser features.
  - i. Test Internet connection.
  - j. Unpack files using compression software.
  - k. Bookmark web addresses (URLs).
  - l. Navigate web sites using software functions (e.g., Forward, Back, Go to, Bookmarks).
  - a. Create calendars/schedules.
  - i. Document results.
  - j. Create tasks (to-do) list.
  - k. Identify PIM applications (MS Outlook, Lotus Notes, and others).
  - l. Manage daily/weekly/monthly schedule using applications such as Notes, MS Outlook, etc.
  - m. Create and send notes, informal memos, reminder using PIM applications.
  - n. Create reminder for oneself.
  - o. Access email messages received.



- p. Access email system using login and password functions.
- m. Create e-mail messages in accordance with established business standards (e.g., grammar, Access library catalogs on the Internet).
- n. Compile a collection of business sites (e.g., finance and investment).
- o. Add plug-ins and helpers to the web browser.
- p. Archive files.
- q. Explore the multimedia capabilities of the World Wide Web.
- r. Utilize online tools.
- s. Communicate via email using the Internet.
- t. Explore collaboration tools.
- u. Explore electronic commerce.
- v. Explore newsgroups.
- w. Compile a collection of business sites (e.g., finance and investment).

### 3 2 1 0 3. Word Processing and Presentations

- a. Create documents (e.g., letters, memos, reports) using existing forms and templates.
- b. Employ word processing utility tools (e.g., spell checker, grammar checker, thesaurus).
- c. Format text using basic formatting functions.
- d. Retrieve existing documents.
- e. Safeguard documents using name & save functions.
- f. Create new word processing forms, style sheets, and templates.
- g. Enhance publications using different fonts, styles, attributes, justification, etc.
- h. Enhance publications using

paint/draw functions.

- i. Format new desktop publishing files.
- j. Output desktop publishing files.
- k. Place graphics in document.
- l. Prepare publications using desktop publishing software.
- m. Use advanced formatting features (e.g., headers/footers/dropped caps, and indexing).
- n. Create computer presentation and handouts in accordance with basic principles of graphics design and visual communication.
- o. Edit presentations.
- p. Insert graphic elements (e.g., graph, clip art, table) in a slide.
- q. Identify hardware items that support presentation software (e.g., scanners, digital cameras, printers, and projection systems).
- r. Print a single slide, an entire presentation, an outline, and notes.
- s. Run slide shows manually and automatically.

### 3 2 1 0 4. Spreadsheets

- a. Create spreadsheets.
- b. Edit spreadsheets.
- c. Print spreadsheets.
- d. Retrieve existing spreadsheets.
- e. Save spreadsheets.
- f. Create charts and graphs from spreadsheets.
- g. Group worksheets.
- h. Input/process data using spreadsheet functions.
- i. Perform calculations using simple formulas.

### 3 2 1 0 5. Data

- a. Enter data using a form.

- b. Locate/replace data using search and replace functions.
- c. Process data using database functions (e.g., structure, format, attributes, relationships, keys).
- d. Perform single- and multiple-table queries (e.g., create, run, save).
- e. Print forms, reports, and results or queries.
- f. Search a database table to locate records.
- g. Sort data using single and multiple field sorts.
- h. Verify accuracy of output.
- i. Maintain shared database of contact information.
- j. Manage daily/weekly/monthly schedule using applications.
- k. Participate in virtual group discussions and meetings.
- l. Apply basic commands of operating system software.
- m. Employ desktop operating skills.
- n. Apply appropriate file and disk management techniques.
- o. Recognize the need for regular backup procedures.
- p. Demonstrate knowledge of central processing unit (CPU) control and architecture.
- q. Identify CPU modes of operations.
- r. Define the role of memory management in an operating system.
- s. Demonstrate knowledge of network operating systems.
- t. Demonstrate knowledge of operating system architecture types.
- u. Demonstrate knowledge of the commands used to handle tasks in

- operating systems.
  - v. Differentiate between microcomputer, minicomputer, and mainframe operating systems.
  - w. Demonstrate knowledge of the basics of process management.
  - x. Demonstrate knowledge of the system utilities used for file management.
- 3 2 1 0 6. Ethics and Security
- a. Demonstrate knowledge of potential internal and external threats to security.
  - b. Assess exposure to security issues.
  - c. Demonstrate knowledge of virus protection strategy.
  - d. Ensure compliance with security rules, regulations, and codes.
  - e. Explore ways to implement countermeasures.
  - f. Implement security procedures in accordance with business ethics.
  - g. Maximize threat reduction.
  - h. Document security procedures.
  - i. Understand how to follow a disaster plan.
  - j. Identify sources of virus infections.
  - k. Understand how to utilize backup and recovery procedures.
  - l. Understand how to load virus detection and protection software.
  - m. Maintain confidentiality.
  - n. Understand how to provide for user authentication (e.g., assign passwords, access level).
  - o. Understand how to remove viruses.
  - p. Report viruses in compliance with company standards.
  - q. Identify the features and benefits of

- quality planning.
  - r. Identify the role of quality within the organization.
- 3 2 1 0 7. History / Quality Assurance
- a. Demonstrate knowledge of changes brought about by quality industry leaders in the world.
  - b. Demonstrate knowledge of successful efforts by industry to improve quality and/or reduce costs.
  - c. Demonstrate knowledge of the historical evolution of quality assurance/total quality management (e.g., Deming, ISO 9000).
  - d. Demonstrate knowledge of the standards/requirements for the Baldrige award.
  - e. Demonstrate knowledge of quality management terminology.

## 10002 Computing Systems

- 3 2 1 0 1. Apply knowledge of operating systems principles to ensure optimal functioning of system.
- a. Interact with/respond to system messages using console device.
  - b. Apply basic commands of operating system software.
  - c. Apply appropriate file and disk management techniques.
  - d. Employ desktop operating skills.
  - e. Follow power-up and log-on procedures.
  - f. Run applications. jobs in accordance with processing procedures.
  - g. Follow log-off and power-down

- procedure(s).
  - h. Handle materials and equipment in a responsible manner.
- 3 2 1 0 2. Clearly document procedures for future use.
- a. Document step-by-step installation and configuration procedures.
- 3 2 1 0 3. Communicate and recognize goal achievement.
- a. Communicate goal achievement.
  - b. Provide recognition for goal achievement.
- 3 2 1 0 4. Configure systems to provide optimal system interfaces.
- a. Apply concepts of privileged instructions and protected mode programming.
  - b. Configure peripheral device drivers (e.g., disk, display, printer, modem, keyboard, mouse, network).
  - c. Allocate disk space, non-sharable resources, and I/O devices.
  - d. Interface peripheral devices/controllers in the computer system (e.g., software and hardware interrupts, exceptions, Direct Memory Addressing [DMA], bus structures).
  - e. Identify standards and issues related to I/O programming and design of I/O interfaces.
  - f. Define hardware-software interface issues for a computer system.
  - g. Apply advanced I/O concepts (e.g., disk caching, data compression, extended memory, magnetic disk/CD-ROM storage and formats).
- 3 2 1 0 5. Configure/modify system as needed.
- a. Build system software command

- |         |     |  |
|---------|-----|--|
|         |     | structures using operating system macro facilities for computer systems.                             |
|         | b.  | Identify scheduling priority in programming.   |
|         | c.  | Identify data requirements.  |
|         | d.  | Review automated scheduling software.  |
|         | e.  | Secure needed supplies and resources.  |
| 3 2 1 0 | 6.  | Determine audience and information needs   |
|         | a.  | Define research questions.   |
|         | b.  | Identify target audience.  |
| 3 2 1 0 | 7.  | Document procedures and actions.   |
|         | a.  | Develop audit trails.  |
| 3 2 1 0 | 8.  | Ensure that hardware and software system components are compatible prior to performing installation. |
|         | a.  | processor, memory, disk space, communications, printers, monitors).                                  |
|         | b.  | Determine compatibility of hardware and Identify hardware requirements (e.g., software.              |
| 3 2 1 0 | 9.  | Ensure that software to be installed is licensed prior to performing installation.                   |
|         | a.  | Verify conformance to licensing agreement.   |
| 3 2 1 0 | 10. | Evaluate information systems problem-solving techniques and approaches.                              |
|         | a.  | Evaluate systems engineering considerations.   |
|         | b.  | Identify potential problems in system implementation.  |
|         | c.  | Summarize application planning, development, and risk management for information system.             |
|         | d.  | Demonstrate knowledge of   |

- critical thinking skills and techniques.
  - e. Demonstrate knowledge of decision-making skills and techniques.
  - f. Develop a plan using data-oriented techniques.
  - g. Determine whether prototyping system is feasible.
  - h. Determine software design process, from specification to implementation.
  - i. Appraise software process and product life-cycle models.
  - j. Assess software design methods and tools.
- Evaluate information.
- a. Determine the accuracy and completeness of the information gathered.
- Explain data communications procedures, equipment and media.
- a. Demonstrate knowledge of the uses of data communications media.
  - b. Demonstrate knowledge of the uses of data communications equipment.
  - c. Demonstrate knowledge of key communications procedures.
3. Explain measurement techniques for increased productivity due to information systems implementation.
- Measure increases in productivity realized by the implementation of information systems.

- 3 2 1 0 11.
- 3 2 1 0 12.
- 3 2 1 0

- a. Identify new and emerging classes of software.
- 3 2 1 0 15. Explain the benefits of hosting a web site on a local server vs. at an ISP (Internet Service Provider).
- a. Compare the advantages and disadvantages of running your own server vs. using a server provider.
- 3 2 1 0 16. Explain the differences between local and wide area networks.
- a. Distinguish between local area networks and wide area networks.
- 3 2 1 0 17. Explain the features and functions of web browsing software.
- a. Identify how different browsers affect the look of a web page.
- b. Demonstrate knowledge of the characteristics and uses of plug-ins.
- c. Demonstrate knowledge of the role of browsers in reading files on the World Wide Web (text-only, hypertext).
- 3 2 1 0 18. Explain the features and functions of web page design software.
- a. Compare/contrast the features and functions of software editors available for designing web pages.
- 3 2 1 0 19. Explain the key functions and applications of software.
- a. Demonstrate knowledge of the function and operation of compilers and interpreters.
- b. Demonstrate knowledge of widely used software applications (e.g., word processing, database management, spreadsheet development).
- c. Demonstrate knowledge of the key functions of systems software.
- 3 2 1 0 20. Explain the role of number systems in information systems.

- a. Identify the role the binary system in information systems.
  - b. Demonstrate knowledge of number systems and internal data representation.
- 3 2 1 0 21. Gather information.
- a. Identify potential sources of information.
  - b. Gather information from selected print and electronic sources.
  - c. Conduct interviews with selected human information sources.
  - d. Evaluate potential sources of information based on established criteria (e.g., affordability, relevance).
  - e. Target audience/user group as a key information source.
  - f. Determine priorities for the information that should be gathered.
  - g. Identify subject-matter experts.
- 3 2 1 0 22. Identify computer classifications and hardware.
- a. Identify types of computer storage devices.
  - b. Identify the hardware associated with telecommunications functions.
  - c. Identify major hardware components and their functions.
  - d. Identify the three main classifications of computers (i.e. micro-, mid-range, & mainframe).
- 3 2 1 0 23. Identify new IT technologies and assess their potential importance and impact on the future.
- a. Identify new technologies relevant to information technology.
  - b. Assess the importance of new technologies to future developments
- & to future knowledge worker productivity.
- c. Identify new & emerging drivers and inhibitors of information technology change.
- 3 2 1 0 24. Monitor and adjust goals.
- a. Obtain support for goals.
  - b. Provide support for goals.
  - c. Monitor goal achievement.
  - d. Adjust goals.
- 3 2 1 0 25. Operate computer-driven equipment and machines.
- a. Run applications/jobs in accordance with processing procedures.
  - b. Secure needed supplies and resources.
  - c. Interact with/respond to system messages using console device.
  - d. Follow log-off and power-down procedure(s).
  - e. Follow power-up and log-on procedures.
- 3 2 1 0 26. Perform customization as requested.
- a. Customize software to meet user preferences.
- 3 2 1 0 27. Perform installation accurately and completely, using available resources as needed.
- a. Select appropriate installation options (e.g., default, customized).
  - b. Configure software to appropriate operating system settings.
  - c. Configure macros, tools, and packages to accomplish simple organizational and personal tasks.
  - d. Differentiate between procedures for an upgrade and for a new installation.
  - e. Differentiate between stand-alone and network installation
- procedures.
- f. Disable/uninstall software that may interfere with installation of new software.
  - g. Install given application/system software on various platforms in accordance with manufacturer's procedures.
  - h. Convert data files if required.
  - i. Verify software installation and operation.
- 3 2 1 0 28. Resolve problems with installation if they occur.
- a. Access needed help using manufacturers' technical help lines or Internet sites.
  - b. Formulate new installation procedure if needed.
  - c. Troubleshoot unexpected results.
  - d. Set short- and long-term goals for assigned areas of responsibility/accountability.
- 3 2 1 0 29. Test and maintain products / services.
- a. Test products for reliability.
  - b. Initiate predictive maintenance procedures.
- 3 2 1 0 30. Troubleshoot computer-driven equipment and machines and access support as needed
- a. Test system using diagnostic tools/software.
  - b. Repair/replace malfunctioning hardware.
  - c. Reinstall software as needed.
  - d. Recover data and/or files.
  - e. Restore system to normal operating standards.
- 3 2 1 0 31. Understand and employ design and color principles.
- a. Assess the impact of various color harmonies on a two-dimensional picture plan.
  - b. Demonstrate knowledge of the two-dimensional picture plan.
  - c. Demonstrate knowledge of the

- nature of color and color harmonies.
- d. Assess how color affects the principles of line, value, shape and form.
  - e. Demonstrate knowledge of the principles and elements of design and their relationship to each other.
- 3 2 1 0 32. Understand data communications trends and issues.
- a. Identify major current issues in data communications.
  - b. Identify data communication trends.
  - c. Demonstrate knowledge of data transmission codes and protocols.
- 3 2 1 0 33. Understand elements and types of information processing.
- a. Identify the elements of the information processing cycle (i.e., input, process, output, and storage).
  - b. Identify types of processing (e.g., batch, interactive, event-driven, object-oriented).
- 3 2 1 0 34. Understand functions and interactions of departments within a business.
- a. Identify the ways in which organizational functions are interdependent.
  - b. Define the role of strategic planning in business.
  - c. Identify types of communication channels (e.g., formal, informal).
  - d. Demonstrate knowledge of the components of a business plan.
- 3 2 1 0 35. Understand how bandwidth affects data transmission and on-screen image.
- a. Demonstrate knowledge of how bandwidths affect data transmission and on-screen image.
- 3 2 1 0 36. Understand how data is organized in software development.
- a. Demonstrate knowledge of how data is organized in software development.
- 3 2 1 0 37. Understand information organization principles.
- a. Demonstrate knowledge of group support technology for common knowledge requirements.
  - b. Demonstrate knowledge of methods for achieving productivity in knowledge work.
  - c. Demonstrate knowledge of the information analysis process.
  - d. Demonstrate knowledge of information technology solutions.
- 3 2 1 0 38. Understand product/service design.
- a. Consider customer satisfaction in determining product characteristics (e.g., usefulness, price, operation, life, reliability, safety, cost of operation).
  - b. Design product (e.g., using brainstorming, thumbnail sketches, rendering).
- 3 2 1 0 39. Understand the differences between a client and a server.
- a. Differentiate between a client and a server.
- 3 2 1 0 40. Understand the fundamentals of operating systems.
- a. Identify major operating system fundamentals and components.
- 3 2 1 0 41. Understand the range of languages used in software development.
- a. Demonstrate knowledge of the range of languages used in software development.
- 3 2 1 0 42. Understand types and functions of businesses.
- a. Define stakeholder relationships (e.g., customers, employees, shareholders, and suppliers).
  - b. Identify business reporting and information flow.
  - c. Identify types of business organizations and functions.
- 3 2 1 0 43. Use available reference tools as appropriate.
- a. Access needed information using appropriate reference materials.
  - b. Access needed information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, work flowcharts).
- 3 2 1 0 44. Use installation and operation manuals.
- a. Access needed information using appropriate reference materials.
- 3 2 1 0 45. Use reliability factors effectively to plan for and create products/ services.
- a. Consider reliability factors (e.g., cost, human, productivity).
  - b. Achieve reliability through maintainability, good design, design simplification, and design redundancy.
  - c. Recognize the relationship of maintainability and reliability.
  - d. Align cost components with quality objectives.
  - e. Classify quality costs (e.g., preventive, evaluation, pre-delivery failures, post-delivery failures).

## **03001 Earth Science (or 53008/03008 – Earth Space Science)**

### **Knowledge of the nature of science**

- 3 2 1 0 1. Evaluate models used in science to explain patterns observed in nature (e.g., rock cycle, heliocentric, geocentric, nitrogen cycle, water cycle).
- 3 2 1 0 2. Evaluate the appropriate use of inferences, assumptions, observations, hypotheses, conclusions, laws, and theories.

### **Composition, characteristics, and structure of Earth**

- 3 2 1 0 1. Identify the characteristics of Earth's layers and the methods used to investigate Earth's interior.
- 3 2 1 0 2. Identify common rocks and minerals based on their physical and chemical properties.
- 3 2 1 0 3. Identify processes and products within the rock cycle.

### **Plate tectonics and related processes**

- 3 2 1 0 1. Identify the historical development and supporting evidence that has led to the theory of plate tectonics.
- 3 2 1 0 2. Analyze the geologic processes involved in the movement of tectonic plates and the landforms produced by their movements.
- 3 2 1 0 3. Identify the types, causes, and effects of volcanoes.
- 3 2 1 0 4. Identify the causes and effects of earthquakes and the characteristics of seismic waves.
- 3 2 1 0 5. Identify how the movement of tectonic plates has influenced climate (e.g., hydrosphere, geosphere, biosphere).

### **Earth's surface processes**

- 3 2 1 0 1. Compare physical and chemical weathering and their effects on landforms.
- 3 2 1 0 2. Analyze the principles and processes of sedimentation (i.e., erosion, deposition).
- 3 2 1 0 3. Identify the properties of aquifers and the movement of groundwater through sediments and rock formations.
- 3 2 1 0 4. Analyze the movement of water through the hydrologic cycle, including energy changes that occur as water changes phase.

### **Mapping and remote sensing**

- 3 2 1 0 1. Identify surface features from topographic maps, photographs, and satellite images.
- 3 2 1 0 2. Interpret topographic and oceanographic maps.
- 3 2 1 0 3. Evaluate the function and benefits of Earth-observing systems (e.g., Landsat, Topex, aircraft, balloons).

### **Geologic time**

- 3 2 1 0 1. Identify appropriate methods of absolute and relative dating for given situations.
- 3 2 1 0 2. Apply the law of original horizontality, the principle of superposition, and the principle of cross-cutting relationships to interpret geologic cross sections.
- 3 2 1 0 3. Identify major events in Earth's history (e.g., mass extinctions, evolution of plants, development of an oxygen- rich atmosphere).
- 3 2 1 0 4. Interpret fossils and geologic evidence to reconstruct Earth's history.

### **Earth's resources**

- 3 2 1 0 1. Identify characteristics of renewable and nonrenewable resources.
- 3 2 1 0 2. Evaluate management strategies for renewable and nonrenewable resources.
- 3 2 1 0 3. Compare various energy production technologies (e.g., fossil fuels, nuclear, solar) and their past, present, and future consequences to the environment.
- 3 2 1 0 4. Identify the impact of humans on Earth (e.g., deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water).

### **Weather**

- 3 2 1 0 1. Analyze the composition and structure of the atmosphere and how it protects life and insulates the planet.
- 3 2 1 0 2. Differentiate between the sources, characteristics, and movement of air masses (e.g., maritime, continental, polar, tropical).
- 3 2 1 0 3. Determine how the transfer of energy throughout the atmosphere influences weather conditions (e.g., hydrologic cycle).
- 3 2 1 0 4. Interpret weather maps and the indicated atmospheric conditions.
- 3 2 1 0 5. Evaluate how local weather is affected by geographic features (e.g., proximity to bodies of water, urban versus rural settings, unequal heating of land and water).
- 3 2 1 0 6. Identify how global climate influences, such as jet streams and ocean

currents, affect weather (e.g., El Niño).

#### **Climate patterns**

- 3 2 1 0 1. Identify the causes and effects of climate changes throughout Earth's history.
- 3 2 1 0 2. Assess how the cycling of carbon, energy, and water between the geosphere, hydrosphere, and atmosphere affects climate.
- 3 2 1 0 3. Determine the effects of climate phenomena (e.g., monsoons, jet streams, El Niño).

#### **Astronomical objects and processes**

- 3 2 1 0 1. Identify the characteristics (e.g., mass, composition, location) of the major and minor objects in the solar system.
- 3 2 1 0 2. Interpret the Hertzsprung-Russell diagram with regard to stellar evolution and star characteristics.
- 3 2 1 0 3. Identify the causes and effects of the cycles of the Earth-Moon-Sun system (e.g., seasons, tides, eclipses, precession, moon phases).
- 3 2 1 0 4. Identify the physical properties of the Sun, its dynamic nature, and its effects on Earth systems.
- 3 2 1 0 5. Identify the matter and forces involved in the evolution of the universe (e.g., big bang theory).

#### **Space exploration**

- 3 2 1 0 1. Compare relative and absolute methods for measurement of astronomical distances.
- 3 2 1 0 2. Evaluate functions and benefits of the different types of ground- and space-based astronomical instruments (e.g., x-ray, optical,

infrared, radio telescopes, spectrometers).

- 3 2 1 0 3. Identify significant manned and unmanned space exploration events, programs, and objectives.
- 3 2 1 0 4. Identify the historical development of astronomy based on the contributions of Aristotle, Ptolemy, Copernicus, Brahe, Kepler, Galileo, Newton, Einstein, and Hubble.

#### **Oceans and coastal processes (OPTIONAL)**

- 3 2 1 0 1. Identify the characteristics of ocean basins, continental shelves, and coral reefs.
- 3 2 1 0 2. Identify the geologic features of coastal geomorphic structures (e.g., barrier islands, estuaries, sandbars, capes, deltas, coral reefs).
- 3 2 1 0 3. Analyze the movement of water through waves, tides, and currents.
- 3 2 1 0 4. Identify the chemical, physical, and biological characteristics of seawater.
- 3 2 1 0 5. Determine the causes and effects of surface currents, coastal upwelling, and density-driven (i.e., thermohaline) circulation.
- 3 2 1 0 6. Identify the effects of human activity on the coastal and marine environment.

### **03007 Physical Geography**

- 3 2 1 0 1. Describe the concepts and interrelationships between continental drift, plate tectonics, and sea-floor spreading.
- 3 2 1 0 2. Describe and explain the principles of rock mechanics.

- 3 2 1 0 3. Identify and distinguish between the processes of physical and chemical weathering.
- 3 2 1 0 4. Describe and explain the Laws of Drainage composition.
- 3 2 1 0 5. Identify processes operating in the fluvial, glacial and shoreline environments.
- 3 2 1 0 6. Explain the concept of dynamic equilibrium.
- 3 2 1 0 7. Explain models of landform development.
- 3 2 1 0 8. Apply concepts of energy to explain distributions of temperature, pressure, wind, and moisture.
- 3 2 1 0 9. Explain and use concepts of the adiabatic process to solve problems and explain weather variations.
- 3 2 1 0 10. Apply concepts of atmospheric physics to explain global climatic patterns.
- 3 2 1 0 11. Relate the concept of index species to climatic distributions.
- 3 2 1 0 12. Discuss aspects of climatic change.
- 3 2 1 0 13. Identify rock classifications.
- 3 2 1 0 14. Compare and contrast thermal and dynamic weather systems.
- 3 2 1 0 15. Explain the process of photosynthesis.
- 3 2 1 0 16. Explain the Copernican Model
- 3 2 1 0 17. Identify the Kinetic Theory.
- 3 2 1 0 18. Summarize the plate tectonic theory.
- 3 2 1 0 19. Explain the laws of thermodynamics.
- 3 2 1 0 20. Distinguish between tensional and compressional landforms.
- 3 2 1 0 21. Describe volcanic activity related to ejecta, plate tectonic activities, and related features.
- 3 2 1 0 22. Identify erosional and depositional landforms.

- 3 2 1 0 23. Describe thermal circulation and the differences between Sea Breezes vs. Monsoonal Wind Systems
- 3 2 1 0 24. Deduce relationships between processes, features, and process-responses and be familiar with the basic assumptions of the scientific perspective.
- 3 2 1 0 25. Summarize the conditions that cause such natural hazards as floods, storms, earthquakes, landslides, volcanoes, and coastal erosion and explain their impact on human beings.
- 3 2 1 0 26. Describe the role water plays in physical geography (i.e. Heat storage, latent heat: gradational work performed by streams, waves, and glaciers)
- 3 2 1 0 27. Explain how hydrologic, tectonic, erosional and atmospheric processes as well as earth-sun relationships are interconnected and together shape the physical environment.
- 3 2 1 0 28. Locate major political and physical features of Earth from memory and compares the relative locations of those features.
- 3 2 1 0 29 Interpret maps and other graphic representations.
- 3 2 1 0 30. Demonstrate how various regional frameworks are used to interpret the complexity of Earth (e.g., vegetation, climate, religion, language, occupations, industries, resources, governmental systems, economic systems).
- 3 2 1 0 31. Analyze the distribution of ecosystems by examining relationships between soil, climate, plant, and animal life.
- 3 2 1 0 32. Analyze an ecosystem to understand and solve problems regarding environmental issues (e.g., carrying capacity, biological magnification, reduction

of species diversity, acid rain, ozone depletion, contamination)

- 3 2 1 0 33. Examines the impact that technology has on human modification of the physical environment (e.g., over-fishing, logging and mining, construction on floodplains, internal combustion engine, toxic waste).

## TECHNICAL LEVEL COURSES

### 03006 Meteorology

- 3 2 1 0 1. Define the role of meteorology as an academic discipline and identify potential career opportunities.
- 3 2 1 0 2. Explain how the Earth constitutes a single interconnected system of systems.
- 3 2 1 0 3. Summarize methods of interpreting and using current environmental data from local and remote sources.
- 3 2 1 0 4. Summarize the basic laws of physics and thermodynamics.

#### Atmosphere

- 3 2 1 0 5. Describe what an atmosphere is and why it is important.
- 3 2 1 0 6. Describe and explain the origin, composition, structure, short-term and long-term behaviors of the earth's atmosphere.
- 3 2 1 0 7. Compare and contrast the Earth's atmosphere with the atmosphere of other planets in our solar system.
- 3 2 1 0 8. Demonstrate how to take air temperatures.
- 3 2 1 0 9. Examine forms of condensation.
- 3 2 1 0 10. Explain the connection between dew point and relative humidity.
- 3 2 1 0 11. Measure wind chill factor.
- 3 2 1 0 12. Relate air masses to weather fronts.

- 3 2 1 0 13. Identify the different types of storms and associated weather.
- 3 2 1 0 14. Explain the composition of the Earth's atmosphere.

- 3 2 1 0 15. Identify the troposphere.
- 3 2 1 0 16. Describe the stratosphere.
- 3 2 1 0 17. Identify on a diagram where the mesosphere is located.
- 3 2 1 0 18. Describe the thermosphere.

#### Solar Radiation

- 3 2 1 0 19. Describe how sunlight arrives as electromagnetic waves.
- 3 2 1 0 20. Explain how radiant energy from the sun provides energy and heat to the troposphere.
- 3 2 1 0 21. Summarize how the earth's atmosphere and solar radiation interact.
- 3 2 1 0 22 Identify what happens when heat is absorbed by gases, liquids, or solids.
- 3 2 1 0 23. Summarize what happens to light when it passes through the atmosphere.

#### Atmospheric Conduction and Convection

- 3 2 1 0 24. Compare and contrast conduction and convection as ways that heat moves around the planet.
- 3 2 1 0 25. Explain how heat is transferred to other materials.

#### Atmospheric Balancing

- 3 2 1 0 26. Summarize the three kinds of energy transfer- absorption, conduction and convection.
- 3 2 1 0 27. Describe the ocean system.
- 3 2 1 0 28. Explain how the atmosphere regulates the Earth's temperature.
- 3 2 1 0 29. Outline how the atmosphere participates in a number of Bio/Geo/Chemical cycles that involve life itself.



### Bio/Geo/Chemical Cycles

- 3 2 1 0 30. Explain the water cycle.
- 3 2 1 0 31. Describe the role of solar energy in the water cycle.
- 3 2 1 0 32. Outline the sulfur cycle.
- 3 2 1 0 33. Describe the nitrogen cycle.
- 3 2 1 0 34. Explain the carbon cycle.
- 3 2 1 0 35. Identify the differences in the amount of carbon in the troposphere with the amount of carbon in the atmospheres of other planets.

### Atmosphere and Climate Change

- 3 2 1 0 36. Describe the properties of CO<sub>2</sub>.
- 3 2 1 0 37. Explain the chemical composition of the Earth's atmosphere.
- 3 2 1 0 38. States how industrial output can interact with the atmosphere through the various Bio/Geo/Chemical cycles, and as a result, can change the way the atmosphere regulates the heat coming from solar radiation.

## 21058 GIS Technology

- 3 2 1 0 1. Identify and describe careers in Geospatial and Geographic Information Systems.
- 3 2 1 0 2. Identify key figures and major innovations in the history of progression of diagrams, charts, maps, and projections.
- 3 2 1 0 3. Distinguish between diagrams, charts, maps and projections and identify specific features you would utilize to recognize each and how those features provide utility.  
Example – a “Contour Map” is really a

- projection/overlay that includes contour lines that depict varying levels of depth/altitude. It is often utilized in Agriculture and Natural Resources to examine erosion issues, water flow, and assist with land modification.
- 3 2 1 0 4. Of charts, maps, and projections, identify the primary usage, where each could be co-utilized, and where each has specific usage.
  - 3 2 1 0 5. Create examples of typical keys/legends for sample diagrams, charts, maps, and projections that would illustrate awareness of usage.
  - 3 2 1 0 6. Identify occupations, activities, and specializations and the types of specific utilization required of particular diagrams, charts, maps, and projections in each of these areas.
  - 3 2 1 0 7. Identify and describe methods used to collect data for construction of diagrams, charts, maps and projections; describe modern and historic equipment.
  - 3 2 1 0 8. Identify the file types associated with various types of data and various utilized formats; measurement, axis, reference, scale -- Excel, ArcGIS, PDF, SQL, etc  
Example Important files :
    - .shp — shape format; the feature geometry itself
    - .shx — shape index format; a positional index of the feature geometry to allow seeking forwards and backwards quickly
    - .dbf — attribute format; columnar attributes for each shape, in dBase IV formatExample Optional Files:

- .prj — projection format; the coordinate system and projection information, a plain text file describing the projection using well-known text format
  - .sbn and .sbx — a spatial index of the features
  - .fbn and .fbx — a spatial index of the features for shapefiles that are read-only
  - .ain and .aih — an attribute index of the active fields in a table or a theme's attribute table
  - .ixs — a geocoding index for read-write shapefiles
  - .mxs — a geocoding index for read-write shapefiles (ODB format)
  - .atx — an attribute index for the .dbf file in the form of shapefile.columnname.atx (ArcGIS 8 and later)
  - .shp.xml — metadata in XML format
  - .cpg — used to specify the code page (only for .dbf) for identifying the character encoding
- 3 2 1 0 9. Identify the file types associated with imaging [vector, raster, shapefiles, DWG, GML, TIF, GIF etc], and their potential usage, advantages, and disadvantages.
  - 3 2 1 0 10. Describe shapefiles and how their utilization impacts projection and can facilitate orientation.
  - 3 2 1 0 11. Describe the impact/facilitation of computers on collection and management of data in this field. Give examples of data that might be included; temperature, direction, elevation & distance, volume, etc.
  - 3 2 1 0 12. Describe the impact/facilitation of computers on the projection/representation of data. Give examples such as graphs, projections, etc.
  - 3 2 1 0 13. Recognize various tools utilized in merging data with representation such as Web Feature Service (WFS), XML/GML, OpenGIS, SOAP, etc.
  - 3 2 1 0 14. Explain the implementation of points, polylines, and polygons in representations

and why each is essential to communicate necessary imagery.

- 3 2 1 0 15. Identify industry standards, standards bodies, consortiums, and reference models in the GIS/Geospatial industry.
- 3 2 1 0 16. Identify potential legal issues associated with Geospatial information.

## 21055 Aerospace Technology

- 3 2 1 0 1. Identify various aircraft flight control surfaces and their functions.
- 3 2 1 0 2. Identify components and explain the functions of aircraft hydraulic system components.
- 3 2 1 0 3. Identify components and explain the functions of aircraft pneumatic systems.
- 3 2 1 0 4. Identify components and explain the functions of aircraft electro mechanical systems.
- 3 2 1 0 5. Describe what conditions would warrant choosing either a hydraulic system, a pneumatic system or an electromechanical system.
- 3 2 1 0 6. Maintain aircraft flight control surface and its associate components.
- 3 2 1 0 7. Identify components and explain the functions of aircraft fuel systems.
- 3 2 1 0 8. Identify components and explain the functions of aircraft environmental control systems (pressurized and non-pressurized).
- 3 2 1 0 9. Identify components of various aircraft landing gear systems.
- 3 2 1 0 10. Perform maintenance and periodic inspection on aircraft engines.
- 3 2 1 0 11. Identify potential construction materials and the advantages of using each in aircraft construction.

- 3 2 1 0 12. Identify areas of construction on an aircraft where reinforcement would be essential to safety.

- 3 2 1 0 13. Explain various types of propulsion and their key advantages.

- 3 2 1 0 14. How does atmosphere and speed affect design of control surfaces? Explain in context of wing, control surfaces, drag, and transport capacity.

- 3 2 1 0 15. Explain visual flight conditions vs. instrument flight conditions.

- 3 2 1 0 16. Identify several types of instrumentation available in modern aircraft that assist the safety of flight in visual flight and instrument flight.

## 10210 Animation

Coursework should represent objectives reflective of the locally adopted process. Those listed below are example/foundational.

### Vector Illustration

- 3 2 1 0 1. Creating vector paths
  - Creating paths with the pencil tool
  - Creating paths with the pen tool
- 3 2 1 0 2. Editing vector paths
  - Adjusting anchor points
  - Adding and removing anchor points
- 3 2 1 0 3. Using mask layers

### Advanced Animation Techniques

- 3 2 1 0 4. Inverse kinematics
  - Animating shapes using the Bone tool
- 3 2 1 0 5. Shape tweens and animated masks
  - Creating a shape-tween animation
  - Adding shape hints & a mask
- 3 2 1 0 6. Filter animation
  - Animating a filter and other effects
- 3 2 1 0 7. Motion editing
  - Using the Motion Editor

Reusing an animation as a motion preset

### Actionsript Animation

- 3 2 1 0 8. Programming Principles
  - Discussing behaviors & scripting
  - Exploring a scripted application
  - Preparing symbol instances
  - Reading instance property values
  - Storing values by using variables
- 3 2 1 0 9. Event listeners and event handlers
  - Implementing continuous motion
  - Controlling speed with a variable
  - Stopping motion when a condition is met
  - Making a clip move when clicked
- 3 2 1 0 10. Creating modular code
- 3 2 1 0 11. Special Classes
  - Creating a document class
  - Extending the Movie Clip class
  - Associating a custom class with an object

- 3 2 1 0 12. Using the Debugger

### Interactive Techniques

- 3 2 1 0 13. Adding audio
- 3 2 1 0 14. Adding a hyperlink
- 3 2 1 0 15. Loading text from an external file

### Video

- 3 2 1 0 16. Video basics
  - Discussing video encoding
  - Converting DV content
- 3 2 1 0 17. Embedding video
  - Importing video
  - Changing playback component parameters internal to file
  - Creating code to respond to cue points

## 21009 Robotics

- 3 2 1 0 1. Build or assemble robotic devices or systems.
- 3 2 1 0 2. Align, fit, or assemble component parts using hand tools, power tools, fixtures, templates, or microscopes.
- 3 2 1 0 3. Troubleshoot robotic systems using knowledge of microprocessors, programmable controllers, electronics, circuit analysis, mechanics, sensor or feedback systems, hydraulics and pneumatics.
- 3 2 1 0 4. Train robots using artificial intelligence software to perform simple or complex tasks such as designing and carrying out a series of tests.
- 3 2 1 0 5. Disassemble and reassemble robots or peripheral equipment to make repairs such as replacement of defective circuit boards, sensors, controllers, encoders, and servomotors.
- 3 2 1 0 6. Perform corrective maintenance on robotic systems or components.
- 3 2 1 0 7. Install, program, and repair programmable controllers, robot controllers, end-of-arm tools, or conveyors.
- 3 2 1 0 8. Read blueprints, schematics, diagrams, or technical orders to determine methods and sequences of assembly.
- 3 2 1 0 9. Analyze and record test results, and prepare written testing and documentation.
- 3 2 1 0 10. Explain complex mathematical information used in robotic operations.
- 3 2 1 0 11. Verify dimensions and clearances of parts to ensure conformance to

specifications, using precision measuring instruments.

- 3 2 1 0 12. Debug robotics programs.
- 3 2 1 0 13. Read and utilize blueprints in the technical process.
- 3 2 1 0 14. Read and utilize production layouts.
- 3 2 1 0 15. Read and utilize technical drawings as necessary in robotic assembly and usage.
- 3 2 1 0 16. Troubleshoot mechanical failures or unexpected problems.
- 3 2 1 0 17. Integrate robotics with peripherals or other equipment.
- 3 2 1 0 18. Demonstrate knowledge of how automated robotic systems increase production volume and precision in a variety of high-throughput operations.
- 3 2 1 0 19. Resolve engineering or science problems using robots.
- 3 2 1 0 20. Analyze test results in relation to design or rated specifications and test objectives, and modify or adjust equipment to meet specifications.
- 3 2 1 0 21. Record test procedures and results, numerical and graphical data, and recommendations for changes in product

## APPLICATION LEVEL COURSES

### 21112 GIS Spatial Applications

- 3 2 1 0 1. Understanding Mapping
  - a. Discuss the history and societal implications of mapping, GIS, and remote sensing.

- b. Identify industry applications for GIS technology.
- c. Compare and contrast various forms of maps in terms of purpose, information, and application.
- d. Identify sources of GIS information and their applicability to GIS projects.
- e. Demonstrate how to read a topographical map
- f. Identify terminology associated with map coordinate systems and location
- g. Interpret location using the Geographic Coordinate System to identify absolute location
- h. Identify terminology associated with maps, map scale, map projections, and orienteering
- i. Explain the Universe Transverse Mercator (UTM) coordinate system
- j. Interpret locations using the UTM coordinate system
- k. Explain how maps are created using aerial photography.
- l. Utilize a GPS unit to collect waypoints, measure distance, and calculate area.
- m. Demonstrate the use of zooming, identifying, bookmarks, selecting, and panning tools.
- n. Explain the components of the map display and the tools in the tool bars of common mapping software.

- 3 2 1 0 2. Data Usage and Format
  - a. Explain the need for and uses of metadata.
  - b. Demonstrate various styles of displaying symbols of data,

- sorting querying, and selection techniques
- c. Demonstrate editing feature data
- d. Explain spatial reference
- e. Demonstrate how to georeference an Image Data Layer and add Control Points
- f. Demonstrate the ability to define page margins and parameters for printing a specific size
- g. Demonstrate effective use of map elements that must be included in a map including title, author, data, legend, scale bar, north arrow
- h. Demonstrate effective use of page space through map scale and frame size
- i. Demonstrate process of creating digital archives of maps utilizing the export command
- j. Edit Layer Properties.
- k. Create Layer Files.
- l. Edit an attribute table by adding a new field with calculating values.
- m. Perform relates and joins with data tables.
- n. Label features.
- o. Insert, copy, and paste data into new data frames.
- p. Create graphs and reports from data.
- 3 2 1 0 3. Demonstrate how to analyze land use, population, and flood zone data.
- 3 2 1 0 4. Create geospatial data.
- 3 2 1 0 5. Create a geodatabase, import existing feature classes into a geodatabase, and import multiple feature classes to a geodatabase.
- 3 2 1 0 6. Plan and build a local data inventory.

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- 3 2 1 0 7. View single band and multispectral images.
- 3 2 1 0 8. Perform various manipulations to an image including creating a subset of an image, mosaic two georeferenced images, and orthorectification.
- 3 2 1 0 9. Perform image analysis by orthorectifying non-georeferenced digital images to existing map features.
- 3 2 1 0 10. Use various tools in image analysis to extract land features from imagery data.
- 3 2 1 0 11. Categorize land cover types using image analysis tools.
- 3 2 1 0 12. Conduct vegetation analysis on imagery using image analysis
- 3 2 1 0 13. Evaluate areas of change in images.
- 3 2 1 0 14. Enhance an image by adjusting the brightness and contrast, adjusting the histogram, applying custom histogram stretches, sharpening and smoothing its appearance.
- 3 2 1 0 15. Measure and Interpolation
  - a. Create a straight line distance calculation.
  - b. Create a surface from a set of features using the Inverse Distance Weighted interpolation method.
  - c. Create a surface from a set of features using the Spline interpolation method.
  - d. Create a surface from a set of features using the Kriging interpolation method.
  - e. Create elevation contour data from an elevation raster.
  - f. Calculate and display slope derived from an elevation raster.
  - g. Determine and display aspect from an elevation raster.
  - h. Create a hillshade surface from an

- elevation raster.
  - i. Calculate the viewshed of a surface to determine visible objects.
  - 3 2 1 0 16. Navigate various types of surfaces.
  - 3 2 1 0 17. Explore methods of obtaining, downloading, and extracting free data using the Internet.
  - 3 2 1 0 18. Build 3D datasets.
  - 3 2 1 0 19. Display 2D features onto a 3D surface.
  - 3 2 1 0 20. Create shapefiles to view in a 3D environment.
  - 3 2 1 0 21. Construct a 3D model of an urban environment.
  - 3 2 1 0 22. Display georeferenced data measurements in 3D.
  - 3 2 1 0 23. Apply Interpolation methods.
  - 3 2 1 0 24. Utilize georeferenced 2D data in a 3D environment to provide valuable information.
  - 3 2 1 0 25. Create contour lines in a 3D environment.
- 21011 Civil Engineering**
- 3 2 1 0 1. Students will describe civil engineering and its significance in areas such as community planning, transportation, and sanitation.
  - 3 2 1 0 2. Students will describe the postsecondary and career opportunities in the fields of civil engineering.
  - 3 2 1 0 3. Students will describe the various individuals and agencies and their roles during the design and development of a civil engineering project.
  - 3 2 1 0 4. Students will outline appropriate sequence of action that may include tasks, personnel, and materials to accomplish a civil engineering project and will continually document and modify that

sequence based on personal review and feedback from others as they develop their project.

- 3 2 1 0 5. Students will identify the criteria and constraints and gather information to promote viable decisions regarding the development of their solutions.
- 3 2 1 0 6. Students will communicate ideas for designing a development project using various drawing methods, develop two and three dimensional sketches, graphics, or other media (including computer assisted media) collected and documented.
- 3 2 1 0 7. Students will communicate the current common practices utilized in civil engineering and apply them to develop a viable solution for an engineering project.
- 3 2 1 0 8. Students will communicate understandings of the relationship of structures and land and the responsibility of designers to handle resources in an ethical manner.
- 3 2 1 0 9. Students will develop and be able to read a contour map.
- 3 2 1 0 10. Students will utilize site geography to appropriately place buildings, allow for drainage, provide aesthetic appeal and moderate external climate (utilizing vegetation and landform) and provide for adequate access and parking.
- 3 2 1 0 11. Students will examine and assess the pros and cons of local, state, and federal regulations on site development.
- 3 2 1 0 12. Students will research and design an appropriate energy system.
- 3 2 1 0 13. Students will calculate and determine the heat loss or gain of the energy systems.
- 3 2 1 0 14. Students will compare and contrast the various elevations views and communicate their understanding of how

elevations are used in the design of the project's structures.

- 3 2 1 0 15. Students will identify the regions of the United States that are susceptible to seismic loads.
- 3 2 1 0 16. Students will research the different types of loads acting on a structure and write a brief description with a diagram in their journals/notebooks.

## **21012 Civil Engineering & Architecture**

- 3 2 1 0 1. Students will compare and contrast civil engineering and architecture.
- 3 2 1 0 2. Students will describe the postsecondary and career opportunities in the fields of civil engineering and architecture.
- 3 2 1 0 3. Students will describe the various individuals and agencies and their roles during the design and development of a civil engineering or architectural project.
- 3 2 1 0 4. Students will outline appropriate sequence of action that may include tasks, personnel, and materials to accomplish a civil engineering or architectural project and will continually document and modify that sequence based on personal review and feedback from others as they develop their project.
- 3 2 1 0 5. Students will identify the criteria and constraints and gather information to promote viable decisions regarding the development of their solutions.
- 3 2 1 0 6. Students will communicate ideas for designing a development project using various drawing methods, develop two and three dimensional sketches, graphics, or other media (including computer assisted media) collected and documented.

- 3 2 1 0 7. Students will communicate the current common practices utilized in civil engineering and architecture and apply them to develop a viable solution for an engineering or architecture project.
- 3 2 1 0 8. Students will communicate understandings of the relationship of structures and land and the responsibility of designers to handle resources in an ethical manner.
- 3 2 1 0 9. Students will conduct a survey of their personal residence and write their observations about the locations of the electrical, water, and sewage access points and setbacks.
- 3 2 1 0 10. Students will develop and be able to read a contour map.
- 3 2 1 0 11. Students will utilize site geography to appropriately place buildings, allow for drainage, provide aesthetic appeal and moderate external climate (utilizing vegetation and landform) and provide for adequate access and parking.
- 3 2 1 0 12. Students will examine and assess the pros and cons of local, state, and federal regulations on site development.
- 3 2 1 0 13. Students will apply their knowledge of architectural styles to the design of the structures.
- 3 2 1 0 14. Students will apply their knowledge of floor plans to the structures.
- 3 2 1 0 15. Students will research and design an appropriate energy system.
- 3 2 1 0 16. Students will calculate and determine the heat loss or gain of the energy systems.
- 3 2 1 0 17. Students will compare and contrast the various elevations views and communicate their understanding of how elevations are used in the design of the project's structures.

- 3 2 1 0 18. Students will draw the exterior and interior elevations.
- 3 2 1 0 19. Students will compare and contrast sections and details explaining their purposes in a set of architectural plans.
- 3 2 1 0 20. Students will draw the sections and details complete with appropriate architectural symbols.
- 3 2 1 0 21. Students will determine and draw appropriate renderings of the mechanical, electrical, and protection systems necessary.
- 3 2 1 0 22. Students will determine the live and dead loads of a structure using load tables and appropriate mathematics.
- 3 2 1 0 23. Students will identify the regions of the United States that are susceptible to seismic loads.
- 3 2 1 0 24. Students will research the different types of loads acting on a structure and write a brief description with a diagram in their journals/notebooks.
- 3 2 1 0 25. Students will identify roofing materials, types of roof systems, rafters and trusses; calculate the load for roof members; and determine the architectural styles that will support the roof system design chosen for their project.
- 3 2 1 0 26. Students will determine the strength of columns and beams required for a structure.
- 3 2 1 0 27. Students will size floor members according to loads and modify section details to show the sizing of supporting materials.
- 3 2 1 0 28. Students will research the various foundation types, draw sketches of each one, and describe their use.
- 3 2 1 0 29. Students will prepare a foundation detail.

## **21013 Aerospace Engineering**

### **History of Flight**

- 3 2 1 0 1. Students will construct a PowerPoint that shows knowledge of the history of flight.
- 3 2 1 0 2. Students will demonstrate an understanding of the knowledge of aerospace history in a PowerPoint that provides insight to future challenges involving travel through the atmosphere and space.
- 3 2 1 0 3. Students will list many types of vehicles that have been designed to fly.
- 3 2 1 0 4. Students shall identify the major components of airplanes which has a specific function in the design and operation of the airplane.
- 3 2 1 0 5. The forces that act on an aircraft which enable it to fly will be listed by the students.

### **Aerodynamics**

- 3 2 1 0 6. Students will identify the forces applied to an airplane in-flight: lift, weight, drag and thrust.
- 3 2 1 0 7. Students will explain how wings provide the lifting forces needed to overcome the weight of an airplane.
- 3 2 1 0 8. Student will demonstrate an understand of power to weight ratio.
- 3 2 1 0 9. Students will demonstrate basic knowledge of aerodynamics and physics.
- 3 2 1 0 10. Students will utilize the design process, with computer simulation tools, to predict the performance of a design prior to the building of a physical model.
- 3 2 1 0 11. Students will utilize the design process to create and evaluate multiple solutions to a problem.

### **Airfoil Construction**

- 3 2 1 0 12. Students design, create, and test prototypes and models of airfoils.

- 3 2 1 0 13. Students create sub-scale models used to represent a full-size system.

- 3 2 1 0 14. Students will apply coordinate geometry to create varied shapes used to design an airfoil.

- 3 2 1 0 15. Students will select appropriate hand tools and equipment, and operate tools and equipment selected to create accurate scale models.

### **Wind Tunnel Testing**

- 3 2 1 0 16. Students will compare and contrast prototypes of auxiliary models.

- 3 2 1 0 17. Students will use scale models to evaluate, to test, and to determine the performance of aircraft designs.

- 3 2 1 0 18. Students will use the wind tunnel to graph, display, evaluate and analyze test data.

### **Glider Design & Construction**

- 3 2 1 0 19. The students will use flight theory to design a glider.

- 3 2 1 0 20. Students predict the flight performance of an aircraft utilizing the mathematics of flight theory.

- 3 2 1 0 21. Students will construct a multi-component device by the use of assembly and alignment jigs.

- 3 2 1 0 22. The student will collect and use flight testing data to evaluate an aircraft design.

- 3 2 1 0 23. Students will construct multiple designs capable of achieving similar results.

### **Measuring Rocket Engine Thrust**

- 3 2 1 0 24. Parts of a model rocket and parts of a model rocket engine are identified by the student.

- 3 2 1 0 25. Students understand and explain how the forces of weight, thrust, drag, and lift interact differently on a rocket in flight.

- 3 2 1 0 26. Students state how Newton's three laws of motions (inertia, F=ma, and action-reaction) can be used to describe and

- predict events during each phase of a rocket launch.
- 3 2 1 0 27. Rockets are designed with features that are interrelated.
- 3 2 1 0 28. The student will calculate the maximum velocity and maximum acceleration of a rocket during flight.
- 3 2 1 0 29. The student will calculate a rocket's maximum altitude by using indirect measurement.
- Rocket Camera**
- 3 2 1 0 30. The internet and the library are used for conducting research.
- 3 2 1 0 31. Students understand and explain applications of aerial photography.
- 3 2 1 0 32. Students use the scientific method to design and project to answer a research question.
- 3 2 1 0 33. Students formulate a research question based on research, gathering data, analyzing data, and making judgments about experimental data.
- 3 2 1 0 34. Students use the scale factor of aerial photographs to determine a rocket's altitude, number, and kind of objects in the photograph, and the dimension of objects in the photographs.
- 3 2 1 0 35. Students use aerial photographs to identify, classify, and enumerate objects in the photograph.
- 3 2 1 0 36. Students understand that a rocket's launch angle affects the forces of lift, thrust, weight, and drag.

#### **Orbital Mechanics**

- 3 2 1 0 37. Students create drawings to show that ellipses are conic sections, and circles are special cases of ellipses.
- 3 2 1 0 38. Students create diagrams to show that orbits involve the steady procession of a

small mass object around a large mass object.

- 3 2 1 0 39. Students calculate to show that an object in orbit is continuously "falling" toward the body about around which they orbit.
- 3 2 1 0 40. Students calculate to show that orbital elements can be used to fully define a satellite's orbit, allowing the accurate prediction of the precise location of the satellite at a given time.

#### **Life Support & Environmental Systems**

- 3 2 1 0 41. Students describe basic physiological needs of the human body when living safely within and outside of Earth's atmosphere.
- 3 2 1 0 42. The students make a model to show how the environment on earth and in space must be considered when designing solutions to problem in aerospace engineering.
- 3 2 1 0 43. Students discuss how engineers have solved many technological challenges faced when designing solutions for living higher atmospheres and space.
- 3 2 1 0 44. Students develop a demonstration of force, mass, and acceleration phenomena or G-forces that astronauts, fighter pilots, and Formula One drivers might experience.

#### **Effect of gravity on the Human Body**

- 3 2 1 0 45. Students simulate a 1-g, Earth-normal, environment
- 3 2 1 0 46. Students simulate the action of spinning and how it can fool the senses and stimulate the vestibular system in the inner ear.
- 3 2 1 0 47. Students work in cooperative and supportive teams to simulate how these behaviors result in increased safety and higher quality data.

- 3 2 1 0 48. Students investigate and give examples of how a stress-filled environment is physically unique and can affect the ability to perform mental functions.
- 3 2 1 0 49. Students identify common equipment that can be used for data acquisition.
- 3 2 1 0 50. Students use spreadsheet software to collect, analyze and report data.

#### **Microgravity Drop Tower**

- 3 2 1 0 51. Students describe gravity and its effects on other masses.
- 3 2 1 0 52. Students state the value of "g" on earth.
- 3 2 1 0 53. Students demonstrate microgravity.
- 3 2 1 0 54. Students describe the microgravity environment associated with the space shuttle.
- 3 2 1 0 55. Students list the types of experiments that can be done in microgravity.

#### **Composites Fabrication & Testing**

- 3 2 1 0 56. Students test multiple layers of material to determine that they are stronger than a single layer of that material.
- 3 2 1 0 57. Students describe the composition of composite materials that are fabricated by molding together layers of reinforced fabric (often glass or carbon fiber) with a plastic matrix, such as epoxy.
- 3 2 1 0 58. Students describe how composite materials are used in the aerospace industry.
- 3 2 1 0 59. Students determine how the strength and stiffness of composite materials can be significantly increased.
- 3 2 1 0 60. The student will assess material performances by comparing strength to weight ratios.
- 3 2 1 0 61. Students will test composite materials using a deflection test to evaluate the stiffness of various composite plastic samples.

#### **Thermal Protection Systems for Space Vehicles**

- 3 2 1 0 62. An understanding of the physics of space vehicle re-entry into the atmosphere is used by the students to design thermal protection systems.
- 3 2 1 0 63. Students demonstrate knowledge of material properties and types of testing when trying to protect a space vehicle.
- 3 2 1 0 64. Students describe the heat transfer process that creates high temperatures in a space vehicle.
- 3 2 1 0 65. Thermal Protection Systems (TPS) are described by the students.

#### **Intelligent Vehicles**

- 3 2 1 0 66. Students will evaluate incentives for building robots.
- 3 2 1 0 67. Students define interactive systems used in science exploration.
- 3 2 1 0 68. Students will interpret electronic data and communication that allows information to be transferred from human to human, human to machine, machine to human, and machine-to-machine.
- 3 2 1 0 69. Students will define the meaning of pH values.
- 3 2 1 0 70. Students will describe uses for robotic devices.
- 3 2 1 0 71. Students will list robotic devices that are composed of mechanical, electrical, and computer based systems that can be programmed to make decisions and control actions based upon sensor readings.
- 3 2 1 0 72. Students will construct a robot device that performs a task.

## **21015 Particular Topics in Engineering**

**Coursework should represent explicit objectives measured against target skills that are not available in other courses and should be enumerated in addition to those listed below.**

**Possible topics (you will have others):**

- Advanced Engineering Design
- Design Improvement Methodology (including and beyond those listed below)
  - Employ effective listening skills when working with client.
  - Employ customer service principles when working with consumers.
  - Evaluate and follow-up on customer service provided.
- Emerging Technology Utilization/Employment (beyond the Emerging Technology Course)

**Additional competencies should reflect the particular work environment and the essential skills addressed reflective of previous coursework.**

- 3 2 1 0 1. Define scope of work (or area to be researched) and appropriately document the process.
- 3 2 1 0 2. Summarize the process of engineering a new design or utilization of material to be examined.
  - a. Plan for products/services using reliability factors.
  - b. Demonstrate knowledge of the key functions and subsystems of the product.
  - c. Demonstrate knowledge of cross-functional team structures and team members' roles.
  - d. Create/evaluate products/services using reliability factors.

- e. Identify testing methodologies, and system analysis requirements.
- 3 2 1 0 3. Assess the importance of new technology to future developments.
- 3 2 1 0 4. Identify trends and major current issues associated with topic.
- 3 2 1 0 5. Demonstrate in depth knowledge resulting from the topic examined (presentation, demonstration, etc).

## **21053 Emerging Technologies**

Coursework should represent objectives reflective of the locally adopted process. Those listed below are example/foundational only.

- 3 2 1 0 1. Demonstrate the research skills necessary to identify and evaluate emerging technologies
- 3 2 1 0 2. Seek and identify sources of information on new technology.
- 3 2 1 0 3. Identify solutions and problems that go beyond the expected and obvious.
- 3 2 1 0 4. Identify sciences and technology areas most impacted and with most potential to utilize the new technologies.
- 3 2 1 0 5. Be able to explain why it is important for STEM professionals to keep abreast of evolving technologies.
- 3 2 1 0 6. Be able to discuss the advantages, disadvantages, and prospects of current emerging technologies.
- 3 2 1 0 7. Discuss in depth a chosen emerging technology, based on independent research.
- 3 2 1 0 8. Explain the change process.



- 3 2 1 0 9. Develop a plan for anticipating change.
- 3 2 1 0 10. Address each of the following areas to varying degrees based on available information:
  - a. anticipated employment,
  - b. drivers and constraints,
  - c. size and location of market,
  - d. connection(s) to existing technologies,
  - e. ability and ease of replication,
  - f. physical and capital costs,
  - g. industry and education partnerships to be leveraged,
  - h. national best practices,
  - i. illustrate qualifications, and recommendations, aims and approaches for the Technological innovation
  - j. Innovation system modeling
  - k. Technology monitoring, forecasting and assessment
  - l. Trend analysis methods & scenarios
  - m. Impact assessment
  - n. Risk analysis
  - o. Action (policy) analysis
  - p. Technology road mapping
  - q. Communication and implementation of innovation forecasts

## 21048 Workplace Experience

- 3 2 1 0 1. Employ effective listening skills when working with client.

- 3 2 1 0 2. Employ customer service principles when working with consumers.
- 3 2 1 0 3. Evaluate and follow-up on customer service provided.
- 3 2 1 0 4. Employ safety skills and equipment usage in appropriate ways.
- 3 2 1 0 5. Be aware of MSDS (Material Safety Data Sheets) and other safety resources and employ those resources as required for the workplace.

## 21205 Project Management and Resource Scheduling

- 3 2 1 0 1. Recognize different resource types (Work, Material, Cost, Budget, Personnel/Skills, Generic, etc)
- 3 2 1 0 2. Understand the concept of scope and demonstrate in context of assessing the size of a project.
- 3 2 1 0 3. Develop plans for project management and resource scheduling.
- 3 2 1 0 4. Identify key personnel and responsibilities for project.
- 3 2 1 0 5. Develop SWOT analysis [Strengths, Weaknesses, Opportunities, and Threats] for project.
- 3 2 1 0 6. Analyze workload of tasks and projects.
- 3 2 1 0 7. Determine required personnel groups and management hierarchy.
- 3 2 1 0 8. Determine resources necessary for project completion.
- 3 2 1 0 9. Determine essential tasks necessary for project completion.

- 3 2 1 0 10. Design potential timelines for assignments.
- 3 2 1 0 11. Explore appropriate technologies for project management and resource scheduling.
- 3 2 1 0 12. Create and present a project management and resource scheduling plan.
- 3 2 1 0 13. Create Gantt charts.
- 3 2 1 0 14. Evaluate and assign resources to tasks.
- 3 2 1 0 15. Implement project management skills to design and complete a collaborative project.
- 3 2 1 0 16. Learn various survey strategies to track project progress.
- 3 2 1 0 17. Develop strategies for monitoring interconnected assignments.
- 3 2 1 0 18. Survey strategies for critical path scheduling.
- 3 2 1 0 19. Create strategies to manage project budgets.
- 3 2 1 0 20. Build survey analysis for customer satisfaction.