Course Description

A. COVER PAGE

1. Course Title
Introduction to Engineering 1

2. Transcript Title / Abbreviation
IntroEngineering

3. Transcript Course Code / Number
H 405

4. School
Monrovia High School

5. District
Monrovia Unified School District

6. City
Monrovia, CA

7. School / District Web Site
www.monroviaschools.net

8. School Contact

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Title/Position: AP Curriculum

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9. Subject Area

- ☐ History/Social Science
- ☐ English
- ☐ Mathematics
- ☐ Laboratory Science
- ☐ Language other than English
- ☐ Visual & Performing Arts (for 2003)
- ☒ College Prep Elective

10. Grade Level(s)
9th through 12th

11. Seeking "Honors" Distinction?

☐ Yes ☒ No

12. Unit Value

- ☐ 0.5 (half year or semester equivalent)
- ☒ 1.0 (one year equivalent)
- ☐ 2.0 (two year equivalent)
- ☐ Other: _____

13. Date of School Board Approval

14. Was this course previously approved by UC? ☐ Yes ☒ No If so, year removed from list?

Under what course title?

15. Is this course modeled after an UC-approved course from another school? ☐ Yes ☒ No

If so, which school(s)?

16. Pre-Requisites
Recommended: Algebra II

17. Co-Requisites
Recommended: Physics

18. Brief Course Description

Introduction to Engineering 1 is a study of the interaction of science and technology as it applies to the automotive transportation system and the engineered sub-systems that allow the automobile to function. These include integrated mechanical, electrical, chemical, and computer engineered systems as well as the mathematics and scientific concepts associated with these disciplines. Students will develop their understanding of science, as it applies to the study of engineered automotive systems, by building on their knowledge of physics and mathematics while conducting investigative research. Students will be engaged in a theoretical program that integrates academic study with technical skills. This course is proposed to prepare and motivate students to pursue a post-secondary education in science and engineering programs.

B. COURSE CONTENT

19. Course Goals and/or Major Student Outcomes

Students will:

- Develop an understanding of the relationship that exists between science and its application in the engineering and design of the automobile
- Utilize project based learning strategies to develop student's critical thinking and problem solving skills
- Understand key elements of how concepts underlying a problem can lead to design and production of a viable solution
- Conduct research and apply tools and technologies employed by engineers in the solution of problems
- Gain an understanding of the various fields of engineering and how the design process may be applied to create new processes, products or systems that are environmentally friendly
- Develop an awareness and understanding how the automobile's history puts it in such prominence in our culture and how that can change with the advent of alternative forms of power applications

20. Course Objectives

Students will:

- Develop an understanding of scientific and engineering design concepts and principles as they apply to the various systems of the automobile (such as cooling, lubrication, ignition, etc. systems that allow the automobile to function)
- Gain the ability to effectively communicate technical and professional information in written, oral, visual, and graphical forms
- Develop critical-thinking and problem-solving skills through direct experience in the laboratory projects, in research investigation, and in inquiry-based activities
- Use technology as a daily tool for the collection, organization, manipulation, and presentation of data
- Apply mathematical skills, conceptual understanding, and applications at all appropriate occasions throughout Introduction to Engineering 1
- Understand professional and ethical responsibility
- Understand that engineering is solving problems by applying principles of mathematics, science, and technology
- Be proficient in communication skills necessary in the field of engineering

21. Course Outline

A. Introduction to Engineering 1
   1. Study of the evolution of science and engineering as it applies to the automobile
      a. History of transportation systems
      b. Sources of power and energy in transportation systems
   2. Relationship the automobile has with science, technology, society, and the environment
      a. Understanding of renewable and non-renewable energy sources
      b. How the science and technologies of the automobile impacts the environment
   3. Safety Unit
      a. Review of equipment, safety rules, and emergency guidelines
      b. Lab procedures
      c. Hands-on use of fire extinguishers

B. Review of science for engineering
   1. Mechanical applications
      a. Elements, atoms, molecules and compounds
      b. Speed and velocity
      c. Force, mass and acceleration
      d. Newton's laws of motion
      e. Forces acting at a point
      f. Work, energy, power
      g. Potential and kinetic energy
      h. Friction
      i. Simple machines
      j. Torque
      k. Pressure in fluids
      l. Heat energy and transfer
      m. Thermal expansion
      n. Ideal gas laws
      o. Measurement of temperature
   2. Electrical applications
      a. Electric circuits
      b. Resistance variation
      c. Chemical effects of electricity
      d. Series and parallel networks
      e. Electromagnetism
      f. Alternating and Direct voltages and currents
      g. Capacitors and inductors
      h. Electrical measuring instruments and measurements

C. Engineering disciplines
   1. Mechanical engineering

2. Electrical engineering
3. Computer engineering
4. Chemical engineering

D. Systems
   1. Mechanical
   2. Electrical
   3. Fluid
   4. Thermal
   5. Environmental

E. Applied physics
   1. Friction, power, and torque
   2. Simple machines
      a. Wheel and axle, gears, and pulleys
      b. Levers, screw, and wedge
   3. Fluid systems
      a. Hydraulic fluid power system
      b. Pneumatic fluid power system
   4. Quantitative measurement
      a. Volts, amps, and watts
      b. Resistance
      c. Pounds per square inch
      d. Torque
      e. Friction
      f. Measuring tools and systems (Metric and Standard)

F. Engineering fundamentals
   1. Problem solving and presentation
      a. Engineering components and systems
      b. Laws of physics
      c. Basic steps in solution of engineering problems
      d. Communication skills and presentation of work
   2. Engineering parameters
      a. Physical dimensions of length and width
      b. Mass and momentum
      c. Force and stress
      d. Temperature and heat transfer
   3. Energy and power
      a. Work, mechanical energy, thermal energy
      b. First Law of Thermodynamics
      c. Understanding power
      d. Watts and horsepower
      e. Efficiency

4. Electronics theory
    a. Electron and conventional current
    b. Voltage
    c. Direct and alternating current
    d. Circuits and components
    e. Electric motors

G. Engineering design
1. Solving engineering analysis problems
    a. Define the problem
    b. Collect information
    c. Generate a solution
    d. Refine and implement solution
    e. Verify and test solution
2. The design process
    a. Working in teams
        - Communication and brainstorming
        - Active listening
        - Time management
        - Resource allocation
        - Information accessing
        - Systems analysis
        - Documentation and written reports
    b. Laboratory applications and problem solving
        - Simulations
        - Feedback

3. Computer operation
    a. Binary
    b. Input, processing, memory, and output
    c. Actuators
    d. Sensors
    e. CAN
    f. Multiplexing
    g. Analog/Digital operation

4. Design considerations
    a. Overview
        - Purpose or application
        - Size and weight
        - Physical restraints
        - Monetary restraints
        - Time element
    b. Specifications
        - Material composition

- Support
- Weight and balance
- Frame
- Detailed parts specifications

c. Sensors
- Light
- Pressure
- Rotational
- Infrared
- Temperature
- Cameras

H. Machine operations
1. Tools, calipers and micrometers
2. Properties of materials
3. Assembly techniques

I. Career pathways
1. Resume writing
2. Applications/internships
3. Interview techniques
4. Career outlook and post-secondary education

22. Texts & Supplemental Instructional Materials

Active Physics, Transportation (2000), Author: A. Eisenkraft, Publisher: It's About Time, Inc.

Modern Automotive Technology (2004), Author: J.E. Duffy, Publisher: Goodheart-Wilcox

Engineering Fundamentals: An Introduction to Engineering, Saeed Moaveni, Thompson-Engineering, 2004

23. Key Assignments

1. Students participate in a series of class competitions to demonstrate the use of the six simple machines to learn the trade-off between torque and speed.
2. Students perform weekly reading and writing assignments related to how each automotive system is engineered.
3. Students diagram, investigate and evaluate the operating and engineering characteristics of the most common power and energy production systems used in motorized vehicles
4. Students assemble a portfolio of laboratory exercises
5. Students participate in team-based projects which gives the student an idea of what it means to manage an engineering process while helping the student master skills and concepts in physics, communication, and problem solving.

24. Instructional Methods and/or Strategies

A variety of strategies and techniques are used to instruct the student. These include the following:

A. Direct Presentation
   1. Instructor lectures and demonstrations
   2. Guest lecturer presentations
   3. Media Presentations (video, online, etc.)
   4. Instructor demonstrations

B. Interactive Presentations
   1. Instructor and/or student directed discussion sections
   2. Interactive lecture sessions (see Hewitt, see Mazur)
   3. Interactive media/computer/ CD tutorials and simulations

C. Collaborative Work
   1. Class work
   2. Tutorials
   3. Projects
   4. Laboratory activities

D. Laboratory Practical Work
   1. Guided and open-ended practical investigations
   2. Guided and open-ended theoretical investigations

E. Student Research
   1. Library
   2. Internet material

F. Project-Based Learning

G. Homework

H. Readings

I. Problem-sets

25. Assessment Methods and/or Tools

Assessment of student performance is based on individual abilities, interests, and talents. Combinations of methods are used to assess student progress. The methods available include but are not limited to the following:

- Regular review of work/problem sets by science teacher
- Portfolios
- Teacher observation
- Student demonstrations
- Student work samples
- Written examinations
- Laboratory projects
- Applied concepts project

C. HONORS COURSES ONLY

Please refer to instructions

26. Indicate how this honors course is different from the standard course.

N/A

D. OPTIONAL BACKGROUND INFORMATION

Please refer to instructions

27. Context for Course (optional)

Engineering of this most complicated and sophisticated piece of machinery and electronics (the automobile) is a modern day marvel. This elective course instills self-confidence and self-worth in the privileged youth at Monrovia High School. The automobile is something that will be an integral part of their lives and the second largest investment, next to a home, for the next 50+ years. This course may also be a precursor for students who are interested in studying mechanical, electrical and environmental engineering.

28. History of Course Development (optional)

It is a universal truth that the automobile was the single most significant influence in world history in the first half of the 20th century, followed by the computer in the second half. The marriage of these two in the 21st century is now also a fact of life. The automobile has up to 28 computers that talk to each other and control the majority of the modern vehicle's moving parts. With the addition of Hybrids, the bar raises again. The modern automobile is a marvel of technical engineering practices. Today's engineering students need an overall view of such complicated vehicles to better focus on their chosen pathway required at the post-secondary level of education. Our goal is to provide that students are able to participate in a sequenced program of theoretical and hands-on, project oriented technology education using relevant mechanical, chemical, and electrical engineering based application enhancing academic core competencies.