

PRINCIPLES OF TECHNOLOGY

JULY 2005

I. COURSE DESCRIPTION

Principles of Technology is a full year study designed primarily for technical students who may or may not be college bound in grades 11 and 12. This course seeks to build a firm foundation for understanding technology by blending an understanding of basic physics principles with practice in applying these principles. It employs a technologically sophisticated system of instruction to increase the flexibility of students entering the job market, thereby increasing their chances of employment and retraining as their careers progress and develop.

Concepts like force, work, and rate are introduced and their applications in mechanical, fluid, electrical, and thermal systems are demonstrated. Each unit builds on knowledge learned in the previous unit to help the student understand modern interdisciplinary systems. The correct use of laboratory equipment will be learned, and laboratory experiments will compliment each area of study.

II. COURSE OBJECTIVES/OUTLINE

A. FORCE

1. FORCE IN MECHANICAL SYSTEMS

The student will be able to:

- (a) Define force, and describe how forces are measured. (S5.3B1; S5.7A2)
- (b) Describe what happens when forces on an object are balanced and when they are unbalanced. (S5.7A1; S5.7A2)
- (c) Explain the meaning of Newton's first law of motion. (S5.7A2)
- (d) Define scalar, vector, weight, mass, and torque. (S5.7A1; S5.7A3)
- (e) Determine the resultant force on an object when two or more forces act upon it. (S5.3B1; S5.7A1)
- (f) Solve problems involving force, lever arm, and torque. (S5.3C1)

2. PRESSURE IN FLUID SYSTEMS

The student will be able to:

- (a) Describe the four states of matter. (S5.6A7)
- (b) Define density and pressure. (S5.6A6; S5.6A7)
- (c) Explain why pressure in a fluid depends on depth in the fluid. (S5.6A6)
- (d) Explain why an object submerged in a fluid experiences a buoyant force. (S5.6A6)
- (e) Predict whether an object will sink or float in a given fluid. (S5.6A6)
- (f) Explain how a force can be multiplied in a hydraulic lift. (S5.6A6)
- (g) Explain where atmospheric pressure comes from. (S5.6A7)
- (h) Describe how a barometer measures atmospheric pressure. (S5.6A6)
- (i) Explain the difference between absolute and gage pressure. (S5.6A6; S5.6A7)

3. VOLTAGE IN ELECTRICAL SYSTEMS

The student will be able to:

- (a) Explain the similarities and differences between Newton's law of universal gravitation and Coulomb's law. (S5.7A2; S5.7A3)
- (b) Explain how the force between two like charges and the force between two unlike charges are different. (S5.7A4)
- (c) Describe how to create an electric field and interpret the information given in a drawing of an electric field. (S5.7A4)
- (d) Define electric potential difference, or voltage. (S5.7A4)
- (e) Differentiate between AC and DC current. (S5.7B1)
- (f) Identify the most common source of DC voltage. (S5.7B1)
- (g) Describe how to connect DC voltage sources so that voltages will add. (S5.7B1)

4. TEMPERATURE IN THERMAL SYSTEMS

The student will be able to:

- (a) Define thermal energy. (S5.6A6)
- (b) Name the property of a body that determines its temperature. (S5.6A6)
- (c) Change Celsius or Fahrenheit temperatures to the alternate scale by substituting in a formula. (S5.3C1)
- (d) Explain the difference between heat and thermal energy. (S5.6A6)
- (e) Explain the relationship between heat transferred to an object and the change in the object's temperature. (S5.7B1)
- (f) Use specific heat, heat of fusion, and heat of vaporization to solve problems involving heat transfer. (S5.3C1; S5.7B1)

B. WORK

1. WORK IN MECHANICAL SYSTEMS

The student will be able to:

- (a) Define work done by a force or torque in a mechanical system. (S5.3C1)
- (b) Explain the relationship between work, force applied, and the distance an object moves. (S5.3C1)
- (c) Solve work problems, given force and distance information in English and SI units. (S5.3C1)
- (d) Explain how efficiency relates to input work and output work for a mechanical system. (S5.7B3)
- (e) Define radian measure of angles. (S5.3C1)
- (f) Explain the relationship between work, torque applied, and the angle (in radians) through which an object moves. (S5.3C1)
- (g) Solve work problems, given torque and angle information in English and SI units. (S5.3C1)

2. WORK IN FLUID SYSTEMS

The student will be able to:

- (a) Describe how open and closed fluid systems are different. (S5.7A1)
- (b) Explain the relationship between work and pressure in a fluid system. (S5.7A1)
- (c) Solve work problems in English and SI units. (S5.3C1)

3. WORK IN ELECTRICAL SYSTEMS

The student will be able to:

- (a) Explain the relationship between work done in electrical systems, charge moved, and the potential difference. (S5.3C1; S5.7B1)
- (b) Calculate the amount of electrical charge in coulombs moving past a point in a circuit. (S5.3A1)
- (c) Define the units of electric current. (S5.7B1)
- (d) Solve electrical work problems, given voltage and charge information. (S5.3C1; S5.7B1)
- (e) Identify the effects of work done in electrical systems. (S5.7B1)
- (f) Explain how efficiency relates to input work and output work in an electrical system. (S5.7B3)

C. RATE

1. RATE IN MECHANICAL SYSTEMS

The student will be able to:

- (a) Define speed, velocity, and acceleration. (S5.7A1)
- (b) Explain the difference between speed and velocity. (S5.7A1)
- (c) Explain the difference between velocity and acceleration. (S5.7A1)
- (d) Use speed, velocity, and acceleration to solve problems involving linear motion. (S5.3C1; S5.7A1)
- (e) Define angular speed and angular acceleration. (S5.7A1)
- (f) Use angular speed and angular acceleration to solve problems involving rotational motion. (S5.3C1; S5.7A1)

2. RATE IN FLUID SYSTEMS

The student will be able to:

- (a) Define volume flow rate. (S5.7A1)
- (b) Solve problems using the volume flow rate equation. (S5.3C1; S5.7A1)
- (c) Define mass flow rate. (S5.7A1)
- (d) Solve problems using the mass flow rate equation. (S5.3C1; S5.7A1)
- (e) Explain how volume and mass flow rates can be measured. (S5.7A1)

3. RATE IN ELECTRICAL SYSTEMS

The student will be able to:

- (a) Define electrical current as a rate. (S5.7B1)
- (b) Describe what is measured by ammeters and voltmeters. (S5.7B1)
- (c) Explain how to connect an ammeter and a voltmeter in an electrical circuit. (S5.7B1)
- (d) Explain why electrons travel at speeds much lower than the speed of light in a conductor. (S5.7B1)
- (e) Define frequency and period. (S5.7B1)
- (f) Explain the relationship between frequency and period. (S5.3C1; S5.7B1)

4. RATE IN THERMAL SYSTEMS

The student will be able to:

- (a) Define heat flow rate and its SI and English units of measure. (S5.7B1)
- (b) Describe the heat transfer processes of conduction, convection, and radiation. (S5.7B1)
- (c) Solve heat transfer rate problems using the heat conduction equation. (S5.3C1;

S5.7B1)

III. TEXTBOOKS AND INSTRUCTIONAL MATERIALS

Physics in Context Cord Communications, Waco, Texas 2005

(Includes textbook teacher guide, lab manual teacher guide, student lab manual, student journal, video correlations, and test databank with examview software)

IV. INSTRUCTIONAL STRATEGIES

Various teaching methods are used in this course. Instruction will be given using prepared worksheets and hand-outs, class notes, unit exercises and preparatory math skills exercises from the book, and videos. Classroom demonstrations and lab activities will be included. Group activities and cooperative learning will be used. In addition, computer based labs using a MultiLogPro system and the internet may be used in this course.

VI. EVALUATION

Students are evaluated using the following criteria:

1. Unit tests
2. Quizzes
3. Lab work
4. Homework
5. Class assignments
6. Class participation
7. Projects
8. Attendance

VII. SCOPE AND SEQUENCE CHART

KEY I=INTRODUCED

D=DEVELOPED IN DEPTH

R=REINFORCED

SKILL TO BE LEARNED

9 10 11 12

Understand and use the metric system		IDR	IDR	IDR
Gain knowledge and understanding of forces		IDR	IDR	IDR
Gain an understanding of vector quantities		IDR	IDR	IDR
Review basic algebra and trigonometry used for problem solving		IDR	IDR	IDR

Gain knowledge and understanding of the uses of graphs		IDR	IDR	IDR
Gain an understanding of pressure		IDR	IDR	IDR
Gain an understanding of AC and DC current		IDR	IDR	IDR
Gain knowledge and understanding of temperature conversions		IDR	IDR	IDR
Gain an understanding of problem solving involving heat transfer		IDR	IDR	IDR
Gain knowledge and understanding of work and measure the effects of work		IDR	IDR	IDR
Gain an understanding of how efficiency relates to input work and output work		IDR	IDR	IDR
Gain an understanding of the relationship between energy and work		ID	ID	ID
Gain knowledge and understanding of open and closed fluid systems		IDR	IDR	IDR
Gain an understanding of rate and how it is measured and controlled		IDR	IDR	IDR
Gain an understanding of linear and angular motion		IDR	IDR	IDR
Gain an understanding of volume and mass flow rates		IDR	IDR	IDR
Gain knowledge of electrical devices and their operation		IDR	IDR	IDR
Gain an understanding of the relationship between frequency and period		IDR	IDR	IDR
Gain knowledge and understanding of heat transfer processes		IDR	IDR	IDR

PASSAIC COUNTY TECHNICAL INSTITUTE

X. STUDENT HANDOUT

PRINCIPLES OF TECHNOLOGY

COURSE OVERVIEW

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Concepts like force, work, and rate are introduced and their applications in mechanical, fluid, electrical, and thermal systems are demonstrated. Each unit builds on knowledge learned in the previous unit to help the student understand modern interdisciplinary systems. The correct use of laboratory equipment will be learned, and laboratory experiments will compliment each area of

study.

PROFICIENCIES

Upon successful completion of the requirements for this course, the student will be able to:

- A. Identify and explain the nature of measured quantities using the SI and English systems of measurement. (S5.3B1)
- B. Explain how forces are controlled, measured, and applied in complex devices. (S5.7A1; S5.7A2)
- C. Review basic algebra and trigonometry to solve problems associated with the course. (S5.3B1; S5.3C1)
- D. Demonstrate an understanding of vector quantities and their use in solving problems. (S5.3B1; S5.7A1)
- E. Explain how to use graphs and the relationship between variables and the shape of the curve. (S5.3D1)
- F. Follow laboratory safety procedures. (S5.1A3; S5.1B1; S5.1C1)
- G. Measure the effects of work in mechanical, fluid, and electrical systems. (S5.7A1; S5.7B1)
- H. Demonstrate the proper use of electrical devices to measure and perform work. (S5.1B1)
- I. Determine the efficiency of machines, and describe the factors that affect their operation. (S5.3A1; S5.7B3)
- J. Demonstrate an understanding of the concept of rate and how it is measured, controlled, and applied in mechanical, fluid, electrical, and thermal systems. (S5.7A1; S5.7B1)
- K. Explain the relationship between the frequency and the period of a wave. (S5.7B1; S5.3C1)
- L. Describe the heat transfer processes of conduction, convection, and radiation. (S5.7B1)