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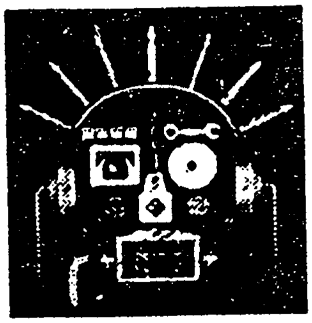
ABSTRACT

This publication contains materials for three courses in Applied Physics in the Applied Academics program at South Seattle Community College. It begins with the article, "Community College Applied Academics: The State of the Art?" (George B. Neff), which describes the characteristics, model, courses, and coordination activity that make up this community college applied academics program. Materials provided for each course include the following: course outline (credit, lecture, and lab hours; course description; prerequisites; learning objectives and hours of instruction); course syllabus (course description; required materials; other policies); and course sequence. The first course is a blend of technology principles with lab practices that involve mechanical, fluid, electrical, and thermal systems used by technicians in their everyday work. The second course is a continuation of applied physics with emphasis on rate, energy, power, momentum, resistance, and force transformers. The third course is a continuation of applied physics, emphasizing energy converters, transducers, vibrations and waves, time constants, radiation, and optical systems. (YLB)



Seattle Tech Prep
Applied Academics Project

Course Materials in Applied Physics

- o Physics 111
- o Physics 112
- o Physics 113

Curriculum Development Sponsor:
Boeing Corporation

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South Seattle Community College
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Applied Academics Project

Community College Applied Academics The State of the Art?

by George B. Neff

2-20-93

The Applied Academics program at South Seattle Community College is of interest to community college educators involved in or curious about Applied Academics at the post-secondary level and it may be the state-of-the-art. This program is being developed with support from Boeing Corporation and help from CORD (Center for Occupational Research and Development, Waco Texas). CORD assisted in defining the distinguishing characteristics of Applied Academics courses used to shape South Seattle's curriculum. South Seattle Community College's courses are based on these characteristics and are part of an Applied Academics education model developed by the college for the purpose of defining and implementing quality education programs. The Applied Academics program includes courses in: Applied Math, Principles of Technology, Applied Communications, Applied Biology and Chemistry (a new area) and a subject area unique to South Seattle; Applied Humanities. These courses are coordinated with one another and with technical courses in several ways and have been validated by a team from Boeing Corporation. This article describes the characteristics, the model, the courses and the coordination activity that make up one of the most complete and interesting community college Applied Academics programs in the country.

BACKGROUND

South Seattle Community College has been blazing a trail in Applied Academics for over two years. The college is one of four institutions that make up the Seattle Community College District. The South campus is located in a heavily industrialized part of Seattle and has developed a strong area of emphasis in vocational and technical education that round out offerings in college transfer, general studies, and continuing education. The school is viewed as an innovator in vocational and technical education with nationally recognized programs in such diverse fields as Hazardous Materials Management, Food Services, Landscape and Horticulture, and Aviation related technologies. Two years ago, with financial assistance from the Boeing Corporation, the campus began to re-examine the way in which it taught academic subjects to vocational and technical students and to consider adopting the concepts, methods, and or materials of the newly evolving, high school curriculum in Applied Academics. The first two years of this effort focused on initial mastery of the concepts and techniques of Applied Academics, the development of prototype curriculum, and the implementation of initial courses. Last summer, a team of faculty from the school m t to document, analyze, and improve current offerings in Applied Academics and to develop some new courses in Applied Biology and Chemistry and in Applied Humanities. The following article describes the results of their summers work.

SECTION I - Distinguishing Characteristics of Applied Academics Courses

The term "Applied Academics" has come to refer to a national standard curriculum consisting of high school courses in Applied Math, Applied Biology/Chemistry and Principles of Technology developed and sold by CORD and similar courses in Applied Communications developed and sold by AIT (Agency for Instructional Technology).

The South Seattle Community College Applied Academics courses are based on the same distinguishing characteristics as the national standard courses and in some cases utilize materials developed by and obtained from CORD or AIT but these are most definitely local products specifically designed for community college students. The development and validation of these courses necessitated the precise definition of the distinguishing characteristics of applied academics courses and the college turned to CORD for help in this critical area.

According to Leno Pedrotti, CORD's founder of Applied Math and Principles of Technology, the distinguishing characteristics of Applied Academics courses include the following:

"Applied Academics courses are competency based, utilize context based learning, integrate academic concepts into technical courses taught in a work place setting, emphasize cooperative learning and stress the use of principles, laws, formulas and rules in the real world as opposed to focusing on proofs of principles and laws, the derivation of formulas, or the evolution of rules."

The emphasis on specific competencies and on putting ideas in context was further stressed in this statement by Leno:

"Applied Academics tries to show the way in which laws, principles, formulas and proofs are used by real people, in the real world, on the job."

The distinguishing characteristics of Applied Academics are summarized as follows:

Applied Academics courses:

- *are competency based*
- *utilize context based learning*
- *integrate academic concepts into technical courses*
- *are taught in a work place setting*
- *emphasize cooperative learning*
- *stress the use of principles, laws, formulas and rules*
- *show how laws, principles, formulas and proofs are used by real people, in the real world, on the job*

The college also developed an ed[illegible] model that supports the implementation of the above characteristics and that defines quality education programs.

SECTION II - The Applied Academics Education Model

The education model includes an Applied Academics mission statement, goals, curriculum guidelines and tools, and instruction guidelines and tools. The purpose of the model is twofold. Not only does the model help insure and facilitate the development of an Applied Academics program that is well anchored in the distinguishing characteristics of Applied Academics, but the model also helps to explicitly define the concept of a quality education and to facilitate the development and delivery of quality education programs.

A. The Mission Statement

The Applied Academics mission statement begins to define a quality education:

"Our mission is to assist in the preparation of persons able to enjoy and discharge the rights, privileges, and responsibilities of citizens in a free society including the rights, privileges and duties of citizenship, vocation, family membership, community membership, and participation in leisure activities."

This mission is consistent with the Presidents education goals, and the SCANS (Secretary's Commission on Achieving Necessary Skills) recommendations, and generally accepted ideas in the tradition of a liberal education as discussed by John Henry Newman in his essays on "The Idea of a University" and the report of the Harvard Committee on a "General Education in a Free Society". Each of these works recognizes that quality education not only prepares good workers but also good family members, community members, and good citizens. The thrust of the current national standard Applied Academics curriculum largely ignores preparation for roles beyond the work place, which is a potentially serious quality problem. South Seattle's Applied Academics program, on the other hand, includes courses in Applied Humanities specifically designed to address preparation for roles not only in but also beyond the work place. The South Seattle Applied Academics mission statement helps focus emphasis on all the roles of a citizen in a free society, a key issue in program quality.

B. The Goals of the Applied Academics Program

The goals of the Applied Academics program are as follows:

"The goals of the South Seattle Community College Applied Academics program are to assist students in leading happy and productive lives as citizens in a free society by providing them with citizenship skills, general work place skills, and specific academic, technical, and vocational skills."

The three level approach to Applied Academics goals (Citizenship, General Work place, and Subject Specific Goals) is unique to South Seattle Community College as far as can be determined but this approach was found to be necessary and useful.

Most skills or competency models (the two terms are used interchangeably in this paper) currently under development try to lump two or more of these categories together and as a result are criticized alternately for over or under emphasis on citizenship vs. work place skills or general vs. specific skills. The three level approach makes the selection of a desirable mix among these elements much easier. The South Seattle goals are defined in more detail in the following section.

Providing Citizenship Skills - Goal 1

Citizenship skills include a knowledge of the rights and responsibilities of citizens in a free society, critical thinking skills, an understanding of work place ethics, knowledge of applied esthetics (i.e. industrial design, human factors engineering etc.), and expertise in applied history (i.e. the techniques of the historian applied to such things as the life cycles of businesses, products, materials and technologies). Esthetics and history are included as citizenship skills because they encourage the consideration of values.

Providing "Citizenship Skills" helps insure that the Applied Academics program turns out not only good workers but also good and complete citizens, a key element is South Seattle's definition of a quality education.

Providing General Work Place Skills - Goal 2

The project did not develop a new list of general work place skills but adopted those skills defined in the SCANS report including five work place competencies and three foundation skills. The SCANS skills seemed adequate for the program and similar enough to the other national general work place competency models being developed to warrant adoption at the time although the college plans to revisit this subject in 1993.

Providing students with "General Work Place Skills" insures that the Applied Academics program and other technical programs turn out individuals not only expert in some vocational or technical facts, but individuals capable of sharing existing facts, acquiring new facts as these become available, applying them in the work place, working effectively with others, assimilating technical change and other job independent, work place skills.

Providing Specific Academic, Vocational, and Technical Skills - Goal 3

Specific academic, vocational and technical skills include academic subject specific, and occupation specific skills that vary with each course of instruction. These skills are developed and documented on a course by course basis.

Providing "Specific Academic, Vocational, and Technical Skills" insure that students receive sufficient specific training to qualify for initial employment and to practice general concepts, theories, laws and proofs.

The Applied Academics goals are based on the mission statement and add specificity to it. The mission statement and goals help insure implementation of the principles of Applied Academics and the delivery of quality education programs but are not complete in and of themselves. What is lacking is a way to insure the incorporation of these concepts into the everyday life of the college. The following Curriculum and Instruction guidelines and tools were adopted or developed for this purpose.

C. Curriculum Guidelines and Tools

The following guidelines assume simple definitions of the terms curriculum and instruction. Curriculum is defined as "what you teach", instruction is defined as "how you teach it".

Curriculum elements in the Applied academics model include a program course mix guideline, a course skills mix guideline, and a standard course outline tool.

Guideline 1 - Course Mix

This guideline insures that technical programs prepare students who are good workers but also good citizens.

"All programs of technical instruction should provide students with a suitable mix of courses in citizenship skills, general work place skills and specific academic, vocational and technical skills."

Guideline 2 - Skills Mix

The second curriculum guideline insures the implementation of the Applied Academics principles of context based learning in general and the principle of the integration of academic materials into technical courses in particular.

"Academic concepts should not only be taught in separate academic courses but should also be integrated into all technical courses."

The Standard Course Outline

The model includes a curriculum tool used to measure the mix of skills included in given course or program, the standard course outline. The standard course outline supports the analysis of program and course level skills mix by spreading total course hours among those citizenship skills, general work place skills and specific academic, vocational and technical skills included in the course.

The hours of instruction identified in each course outline may be added together to evaluate the overall mix of instruction provided in any existing or proposed program of study. This approach provides a general control over course and program mix.

D. Instruction Guidelines and Tools

Instruction elements included in the model are a Context Based Instruction Guideline, a Cooperative Learning Guideline, a Utility Guideline and a Course Syllabus Tool. These elements implement the distinguishing characteristics of Applied Academics.

Guideline 1 - Context Based Instruction

Applied Academics courses, more than anything else, teach abstract ideas by putting them in "context".

"Applied Academics courses should be taught in the context of real world settings including the work place, home, and community."

Guideline 2 - Cooperative Learning Techniques

Today's work place puts heavy emphasis on team work. This emphasis is reflected in the Applied Academics program.

"Applied Academics courses should emphasize cooperative learning as a primary instruction model where appropriate."

The college also emphasizes capstone team projects in year two of technical degree programs.

Guideline 3 - Utility

The utility guideline is a key in transforming traditional academic courses into Applied Academics courses.

"Applied Academics courses should stress the use of principles, laws, formulas, and rules in the real world as opposed to the proof of principles and laws, the derivation of formulas, or the evolution of rules."

Guideline 4 - Competency Based Instruction

Competencies or Skills (the terms are used interchangeably in this document), are a key in tieing together instruction between high school and the community college or between related courses in a series of courses.

"Applied Academics courses will provide instruction in clearly defined Citizenship Skills, General Work Place Skills, and Subject Specific Skills."

The Standard Course Syllabus

The above instruction guidelines are reflected in the standard course syllabus. The standard syllabus encourages instructors to consider and to describe the implementation of the above instruction guidelines when creating or selecting teaching methods for Applied Academics courses.

The above Applied Academics education model, including the mission statement, goals, curriculum guidelines and tools and instruction guidelines and tools support the development and implementation of quality Applied Academics programs at South Seattle Community College.

SECTION III - Impacts of the Model on Instructors

Instructors have had a variety of feelings and experiences in attempting to deal with the subject of applied academics and to understand and use the concepts and tools described in this article. Some general patterns appear to be as follows.

In the initial phases of Applied Academics some of the teachers trained in classic academic disciplines felt suspicious about the heavy work place emphasis of the program and doubtful about course and program quality and intent.

In an effort to deal with these initial concerns academic teachers were drawn together with technical faculty and representative of the business community for twice monthly meetings during the summer of 1992.

This project known as the Applied Academics Task Force operated with funding support from the Boeing Corporation and had as its goal the definition of the Education Model described in this article, the development of the Applied Humanities and Applied Biology and Chemistry courses and the analysis and documentation of the college's existing courses in Applied Math, Principles of Technology, and Applied Communications.

The project provided academic and technical teachers with an opportunity to get together outside the press of the academic year, to develop some additional rapport and empathy and to take control, in a sense, of what had been a potentially troublesome topic. This process in and of itself helped teachers feel more in control of things.

The isolation of the distinguishing characteristics of Applied Academics and the reduction of these concepts to some practical guidelines and tools for course development, curriculum and instruction also helped individuals in their understanding of and comfort with this subject.

A related pattern also emerged. It became clear that every teacher involved in the project was already teaching Citizenship Skills, General Work Place Skills and Specific Skills in every course without being asked to do so and, in some cases, without really focusing on this fact. Once the three part skills structure (Citizenship Skills, General Work place Skills and Specific Skills) was defined the teachers quickly saw the pattern in their courses. The fact that all the teachers, academic and technical, shared an interest in all three skills areas helped bond the group.

The structure also was a challenge to the instructors when it came to allocating course hours to skills. It was often the case that more then one kind of skill was taught in a single course activity, for instance, presenting a project to the class could involve not only speaking skills but also an understanding of technical facts related to the project, thinking, speaking, listening, and teamwork skills. These structural challenges were ultimately met with some creative solutions by the team members.

In summary, instructors finished the project with a better appreciation of one another and a new confidence in their ability to define and deliver Applied Academics courses.

SECTION IV - Courses in the Applied Academics Program

The Applied Academics program at South Seattle Community College includes three courses in Applied Math, three in Principles of Technology, four in Applied Communications, four in Applied Biology/Chemistry, and four in Applied Humanities.

The courses in Applied Humanities are unique to South Seattle and include Applied Civics, Applied Philosophy, Applied History and Applied Art. Some detail regarding these courses is provided below because they are unique to South Seattle

A feel for the content of the program is provided in the following course highlights:

Applied Math

Applied Math is currently a three course series. The first course in the series introduces students to applied algebra, geometry, trigonometry, and statistics. This course includes algebraic operations, exponents, roots, scientific notation, dimensional analysis, significant digits, the metric system, first degree equations, plane and solid geometry, solution of right triangles, functions, graphs, descriptive statistics, calculator fundamentals, and applications. This course is designed to be compatible with the modules used in CORD's Applied Mathematics curriculum.

Principles of Technology

The first course is a blend of technology principles with lab practices that involve Mechanical, Fluid, Electrical, and Thermal Systems that are used by technicians in their everyday work.

The second course is a continuation of applied physics with accentuation on rate, energy, power, momentum, resistance and force transformers.

The third course is a continuation of applied physics with accentuation on energy converters, transducers, vibrations and waves, time constants, radiation, and optical systems.

Applied Communications

The first course is designed for technical students and serves as an introduction to communication skills in the work place. Students assess, practice, and improve their oral and written skills in a variety of business formats. This course is coordinated with a computer application course to encourage integration of writing and computer skills.

The second course involves the preparation of a detailed career plan by each student and results in the production of a document in a formal business report format with front matter, a body and complete back matter. This course interfaces with the schools counseling and career services functions, uses skills and careers data banks and library business reference functions, and involves extensive use of the computer.

The third course is coordinated with the students technical program and focuses on communications issues related to second year technical capstone projects. During the year students develop project plans, status reports, research plans, conduct research, do project reports and make speeches. At the end of the year the technical projects, reports and speeches are presented to business advisors and prospective employers in formal end of the year meetings.

Applied Biology and Chemistry

This is a four course series. In these courses biology and chemistry are treated as a unified science.

The first course includes the sources, uses, and problems relating to natural resources and the properties, uses, quality and cycles of water, air and other gases. This course is designed to be compatible with the modules used in CORD's Applied Biology/Chemistry curriculum.

The second course includes components of the continuity of life including genetics, reproduction, and evolution. Food sources and effects of diet on nutrition and disease transmission, prevention, and treatment in plants and animals are also discussed.

The third course included photosynthesis and the role of nutrients in plant growth and reproduction; animal anatomy and physiology of life processes; and types, benefits and hazards of microorganisms to humans as well as biotechnology applications of microorganisms.

The fourth course includes the sources, properties, and uses of synthetic materials; control of home, community and industrial waste, and waste management; and animals and plants sharing space and resources in a community.

Critical Thinking and Ethics in the Work Place (Applied Philosophy)

Critical Thinking and Ethics in the Work place is an introduction to critical thinking, logic and scientific reasoning with applications to other courses, everyday life and work. It is been created with technical education students in mind; whenever possible topics are related directly to the programs of study and future careers of technical education students.

Responsibilities and Rights of Citizenship (Applied Civics)

This course examines individual rights and responsibilities in a free society in the practical context of and individual's roles as a citizen and resident of various levels of government, family member and employee or employer. The course distinguishes between legally enforceable rights and obligations and those rights and responsibilities that are considered essential to a free society. The course assists students in thinking clearly about these issues and adds the dimension of values to the process of this critical thinking.

Lifecycles of Business, Products, and Technologies (Applied History)

This course enables students to use history: its content, analytical process, research methods, analytical methods and writing techniques to anticipate, understand and benefit from changing technology. The course provides the student with insight into the nature of the life cycles of products, materials and processes using the techniques of research, analysis, and writing of history.

Industrial Design And Human Factors (Applied Art)

This course assists the student in developing an esthetics approach to technology and the world of work. The concepts of quality, beauty, good design, and a good work environment are explored from a variety of viewpoints including the philosophical, multi-cultural, psychological, economic, and technological. The course considers esthetics values, the psychology of perception, social values, economics and design, production, materials, and vocational applications.

SECTION V -Inserting New Applied Academics Courses into Established Programs

An interesting set of problems occur when considering how to insert new courses in Applied Academics into existing technical programs. The first fact usually associated with this process is that there is never any extra time for additional courses. The inevitable consequence of this is that new courses must be used as substitutes for existing courses. All the courses described above were developed as substitutes for existing traditional academic courses, some of which were required some electives. But course substitution can be a real pandora's box.

Usually, instructors of current academic courses are schooled in traditional academics and are not hired to be experts in the nuances of the work place. These instructors sometimes see work place preparation as something separate from academics and sometimes beneath traditional academics and may or may not be inclined toward change in any event. Even in the best of cases, where academic instructors are expert in the ways of the work place, enthusiastic about the mission of work place preparation and natural innovators they may not be conversant with the distinguishing characteristics of Applied Academics and the underlying methods of Applied Academics and will therefore be unable to develop and deliver suitable applied courses.

The solution to these problems are not easy to implement but they are simple conceptually. The first decision to make is "can the instructor of an existing traditional academic course develop and deliver a substitute Applied Academics course?". If the answer is not a resounding unqualified yes, then the best approach is recruiting. The second decision to make, if the answer is yes, is "what kind of help will that instructor need in developing and implementing the course?". Some answers to this second question from South Seattle's experience are:

- Provide compensated time outside the press of daily affairs for training and course development.
- Assign instructors to work in teams that include academic instructors, technical instructors and business people.
- Discuss underlying education values.
- Provide an Education Model or some other form of structure within which course development occurs and that insures conformance to agreed upon concepts and values.

The processes of developing Applied Academics courses and of inserting them into existing technical programs present some real challenges but success is possible given the right approach.

SECTION VI - The Coordination of Applied Academics Courses

The distinguishing characteristics of Applied Academics courses suggest that much can be gained from demonstrating the application of academic concepts by relating the concepts to technical subjects.

South Seattle's experience in this area began with the development and implementation of two coordinated courses, an Applied Academics course in Communications, and a course in Computer Applications. In these coordinated courses, students were taught concepts in written and oral communications, and research in the Communications class and were then given a chance to apply these concepts using computer tools (i.e. word processors, presentation graphics and aides, CD-ROM and on-line data bases). This effort met with great success and has led to the coordination of new Applied Communications courses with campus career services and with second year, capstone technical projects.

One of the difficulties in developing and implementing such coordinated courses is the extra time it takes instructors to develop the course and coordinate delivery. The college is fortunate in being able to use faculty development funds to provide stipends to two instructors each quarter, to develop and deliver one new set of coordinated courses.

SECTION VII - Business Validation

The South Seattle Community College Applied Academics program is being validated by the Boeing Corporation as part of their ongoing support to the project. A team of Boeing executives representing corporate business practices, pre-employment screening, and management development, were asked to evaluate all the Applied Academics courses at a high level and to evaluate the Applied Humanities courses in detail. The Boeing team found that the overall Applied Academics program design was on target and that the proposed courses in Applied Humanities were in some cases necessary and in some cases desirable. The Boeing team also proposed some changes on a course by course basis that are being incorporated in the design.

SECTION VIII - Summary

South Seattle's Applied Academics program is still evolving and is by no means complete at this time but the existence of a formal Applied Academics Education Model coupled with community college courses in the newer areas of Applied Communications, Applied Biology and Chemistry and Applied Humanities make it one of the most complete and innovative programs of its type, it may be the state-of-the-art.

Some major issues in Applied Academics have yet to be explored by the college and are targeted for future inquiry. On question is "Do employers really want students who think for themselves and who have highly developed ethical sensitivities?". Another is "Are students who have spent time mastering citizenship competencies and general work place competencies at a disadvantage in competing for entry point jobs with students who do not have these skills but have more occupation specific skills. The question will be explored with the help of a team of Boeing Executives in the coming months.

Another question is the relationship of Applied Academics to English-as-a-Second Language (ESL), and Adult Basic Education (ABE) programs. The Applied Academics courses are required courses for students in a wide range of technical programs. Students taking courses in ESL, ABE might benefit from the principles of teaching in applied context, making it easier for special population of students to access college-level education.

These are but a few more interesting issues to be explored in the further development and refinement of Applied Academics at South Seattle Community College in the future.

COURSE OUTLINE

DEPARTMENT:	Technical Education Division
PROGRAM:	
CURRICULUM:	Applied Technology
COURSE TITLE:	Technical Physics 111
COURSE NUMBER:	PHY 111
COLLEGE TRANSFER:	No
TYPE OF COURSE:	Vocational/Technical
CREDIT HOURS:	5

Lecture Hours	27
Lab Hours	55
Home Work Hours	54
Total Hours	136

CLASS SIZE: 24

COURSE DESCRIPTION: A blend of technology principals with lab practices that involve mechanical, fluid, electrical, and thermal systems that are used by technicians in their everyday work.

COURSE HISTORY: Originally developed by F.W. Busby, September, 1991
Updated version developed by F.W. Busby, May 1993

PREREQUISITES: Math 111, or concurrent registration or permission of instructor before registration.

LEARNING OBJECTIVES:

Formula Interpretation

1. Define the following terms as used in physical and mathematical equations:

Constants	Variables
Physical	Independent
Mathematical	Dependent

COURSE OUTLINE (CONT.)

Dimensional Analysis

2. Distinguish between fundamental and derived units.
   Give examples of each type of unit.
   Explain the term "dimensionless quantity".
   Given an equation and the units of each term, determine the units of the solution

International System of Units

3. A discussion of the "SI" system of measurements, derived from the old MKS system of dimensions. Demonstrate a deep understanding of the seven basic SI units and two supplementary units and give the symbol and quantity measured for each. List the derived units and symbols for each of the following:
   - Frequency, force, energy.
   - Power, electrical charge, electrical potential, electrical resistance.
   - Demonstrate a knowledge of engineering notation.
   - Convert English and metric factors back and forth.

Angles and Triangles

4. Definition of angle and variations of angles.
   Units of angular measure in degrees and radians.
   Measurement of angles with a protractor.
   Triangles: types, similar, right,
   Functions (trigonometric ratios), inverse functions.
   Finding unknown components of triangles.
   Vectors: vector addition by use of trigonometric functions.

Vectors and Scalars

5. Definitions, similarities, and differences.
   Mathematical manipulation of vector and scalar quantities, and graphical representation of scalar and vector values.
   Using trigonometric ratios to solve vector problems.

Force and Force-like Quantities

6. Define and state the units of the following quantities:
   - Force, torque, pressure,
   - Temperature difference, voltage.
7. Given two or more mechanical forces acting along the same line, determine the resultant force.
8. Given two of the following quantities determine the third:
   1). Force, lever arm, torque.
   2). Force, area, pressure.
   3). Pressure, height of fluid, density of fluid.
9. Given two or more voltage sources connected in series determine the resultant voltage.

COURSE OUTLINE (CONT.)

10. Describe how: Pressure in fluid systems, voltage in electrical systems, and the temperature difference in thermal systems, are similar to force and torque in mechanical systems.
11. Describe the conditions that must be met for equilibrium in each of the following energy systems:
    Mechanical, fluid, electrical, thermal.

Work and Energy

12. Define the following units of work and energy:
    Foot-pound, Newton-meter, Joule, British thermal unit, calorie.
13. Define the following terms and explain their usefulness in determining work done:
    Radian (mechanical system),
    Current (electrical systems),
    Specific heat (thermal system), and
    Heat capacity (thermal system)
14. Give two of the following quantities in a mechanical system determine the third:
    Force, work, displacement
    Torque, work, angular displacement
    Work, voltage, charge transfer
    Work, pressure difference, and volume displaced.
15. Given the temperature difference across a uniform thickness of a substance, the dimensions of the substance, and its thermal conductivity, calculate the heat-flow rate through the substance.
16. Given two of the following quantities in a thermal system, determine the third: Heat capacity of object, temperature change of object, work (heat energy transferred).
17. Define and give examples of latent heat and sensible heat.
18. State the general equation for work. Explain how it applies to each of the following energy systems:
    Fluid, electrical, thermal,
    Mechanical translational, mechanical rotational.

Rate

19. Define the following rates and where applicable, express their basic units in both SI and English systems of units:

Speed and velocity	Acceleration
Angular velocity	Angular acceleration
Volume-flow-rate	Mass-flow-rate
Electric current	Heat-flow-rate

COURSE OUTLINE (CONT.)

20. In the associated system, given all the quantities except one in each of the following groups, determine the unknown quantity:

    Linear Mechanical
    1) Displacement, elapsed time, velocity.
    2) Mass, force, acceleration.
    3) Initial velocity, final velocity, elapsed time and acceleration.

    Rotational Mechanical
    1) Angular displacement, elapsed time, velocity
    2) Initial angular velocity, final angular velocity, elapsed time, angular velocity.

    Fluid system
    1) Volume of fluid moved, elapsed time, volume-flow rate.
    2) Mass of fluid moved, elapsed time, mass-flow rate.

    Electrical system
    1) Charge transferred, elapsed time, mass-flow rate.

    Thermal system
    1) Heat energy transferred, elapsed time, heat-flow rate.
    2) State the general equation for rate, and explain how it applies to each of the following energy systems:
       Mechanical translational, mechanical rotational, fluid, electrical, thermal.

<u>Resistance</u>

21. Define resistance in a general way and state the final form of energy expended when a force-like quantity does work to overcome resistance in any energy system.
22. Calculate the magnitude of starting and sliding frictional forces, given the mass or weight of the object, the coefficients of friction, and the angle of incline.
23. Given two of the following quantities in fluid, electrical, or thermal systems, determine the third: force-like quantity, rate, resistance.
24. Describe the differences in laminar and turbulent flow.
25. State the factors contributing to fluid resistance in pipes.
26. State the factors contributing to electrical resistance in wires.
27. State the factors contributing to thermal resistance of objects.
28. Describe with the use of graphs, the definition of resistance as the ratio of force-like quantity to rate in fluid, electrical, and thermal systems. Include the units of force-like quantity, rate, and resistance for each system.
29. State the fundamental difference between sliding friction and resistance as they apply to fluid, electrical, and thermal system.

REQUIRED TEXT:

Unified Technical Concepts: Physics For Technicians and Lab Book to Accompany Physics for Technicians. Published by the Center for Occupational Research and Development.

Evaluation and Grading.

This is a competency based course. This means that for each assignment there are a list of specific skills to be exhibited, as defined in the course outline.
Grading will be based on the following percentages:

Lab work	36%
Final Exam	32%
Mid term Exam	16%
Home work	16%

COURSE SYLLABUS

General Information:	
Quarter:	FALL
Course Number:	PHY 111
Course Title:	Technical Physics 111
Section Number:	01 Days, 02 Evenings
Instructor:	Bill Busby
Office Location:	Technical Education
Office Hours:	9:30 am to 6:00 pm, Monday and Wednesday
Office Phone Number:	764-5390
Home Phone:	244-2691
Room Number:	TC 120
Lab Hours:	8:00am to 9:30am, 6:00pm to 9:30 pm (Mon & Wed)
Course Description:	A blend of technology principals with lab practices that involve mechanical, fluid, electrical, and thermal systems that are used by technicians in their everyday work.
Required Materials:	United Technical Concepts; Physics for Technicians
Optional Materials:	Lab book to accompany Physics for Technicians
Course Sequence:	Please see attached.
Evaluation Policy:	All grades will be added (100 max). 40 points will be subtracted from the total. The difference will be multiplied by 4 and divided by 60. This result is the grade (i.e., 70% - 40 = 30, 30 x 4 = 120, 120/60 = 2.0).
Grading Procedure:	Lab Work = 36 Final Exam = 32 Mid Term = 16 (include Quizzes) Homework = 16
Other Policies:	There will be zero % for any assignment or test where cheating is evident. Make up exams must be arranged for before the exam in question, and will be at the instructors discretion.

PRINCIPLES OF TECHNOLOGY - PHY 111

LEARNING OBJECTIVES:	HOURS OF INSTRUCTION
A. CITIZENSHIP KNOW-HOW:	
1. RIGHTS AND RESPONSIBILITIES OF CITIZENS	
2. WORKPLACE ETHICS	3
3. APPLIED ART, GRAPH MAKING	1.5
4. APPLIED HISTORY	6
5. CRITICAL THINKING (See section B. 3.)	
B. WORKPLACE KNOW-HOW:	
FIVE WORKPLACE COMPETENCIES	
1. Resources:	
1) *Time*	
2) *Money*	
3) *Material, Facilities and Care of Equipment*	3
4) *Human Resources*	3
2. Interpersonal:	
1) *Participates as Member of a Team*	3
2) *Teach Others New Skills*	2
3) *Serves Clients/Customers*	
4) *Exercises Leadership*	
5) *Negotiates*	
6) *Works with Diversity*	
3. Uses Information	
1) *Acquires and Evaluates Information*	
2) *Organizes and Maintains Information*	
3) *Interprets and Communicates Information*	
4) *Uses Computers to Process Information*	15
5) *Accumulate Data to Ascertain Validity of Experiments*	
4. Systems:	
1) *Understands Systems*	6
2) *Monitors and Corrects Performance*	
3) *Improves or Designs Systems*	
5. Technology: (See Section C.)	
THREE FOUNDATION SKILLS	
1. Basic Skills:	
1) *Reading*	
2) *Writing*	
3) *Arithmetic/Mathematics*	20
4) *Listening*	
5) *Speaking*	

THREE FOUNDATION SKILLS (Cont.)

2. Thinking Skills:

1) *Creative Thinking*	3
2) *Decision Making*	3
3) *Problem Solving*	
4) *Seeing Things in the Minds Eye*	6
5) *Knowing How to Learn*	
6) *Reasoning*	6

3. Personal Qualities:

1) *Responsibility*	3
2) *Self-Esteem*	
3) *Sociability*	
4) *Self-Management*	
5) *Integrity/Honesty*	3

C. ACADEMIC SUBJECT/OCCUPATION SPECIFIC KNOW-HOW; includes academic subject competencies such as:

Reading
Look up information in alphabetical order.
Use the dictionary.
Use the various parts of a textbook.
Recognize and use technical vocabulary in a technical area.
Read and interpret common signs and symbols in diagrams, tables, and charts.
Follow basic written directions for classroom work.
Follow procedural instructions for basic computer and software operation.

Writing
Fill out a job application.
Alphabetize a list.
Recognize and write a simple sentence with correct capitalization and punctuation.
Write several sentences on a topic in paragraph form.
Use the spell-check to verify spelling.
Use computer thesaurus to find alternate vocabulary.
Write a memo in the standard format.

Communication (Listening and Speaking)
Demonstrate understanding of and follow written and verbal instructions.
Ask for pertinent information or instructions.
Express ideas and add details as required.
Recognize learning styles (visual/auditory/tactile).
Make an oral self-introduction.

Group Work
Be willing to interact with others for a common purpose.
Peer-edit written documents.
Provide verbal feedback to other students or instructor.

Submitted by: Date:
Approved by: Date:

COURSE SEQUENCE PHY 111

Supplement 1:

Define by the use of mathematical equations:
Physical and mathematical constants, independent and dependent variables.
Solving formulas and equations (statements of equality).
Fundamental laws of equations, if a change is made in one side of an equation, the change must also be made on the other side.
Sup1 problems: 1, 3, 5, 9 and 15.

Supplement 2:

Systems of units, fundamental, derived, dimensionless quantities.
Dimensionality and conversion.
Sup2 problems: 1, 3, 5, and 16.

Supplement 3:

S. I. units and definitions. Seven basic (SI) units.
Names and symbols of multipliers from 10-18 to 1012.
(Engineering system of S.I. units).

Conversion of English to SI units, non-SI units, and special units.
Sup3 problems: 1-a, 1-3, 1-i, 2-b, 7, 9, and 10.

Supplement 4:

Trigonometric functions and inverse trigonometric functions.

Vectors and vector addition.
Problems: 1, 2, 3, 4, and 5.

Supplement 5:

Vectors and scalars, conversion of vector quantities to graphical vectors.
Addition of vectors graphically. Graphical components and mathematical solutions to vector problems.
Sup5 problems: Show all the work necessary to solve problems 1 thru 4.

Supplement 7:

Logarithms, exponents and powers of ten. Arithmetic uses expressed as powers of ten.
Logarithms of numbers and antilogarithms of logarithms.
Formulas containing logarithms. Natural logarithms and their applications.
Sup7 problems: 1, 8, 10, and 12.

COURSE SEQUENCE (CONT.)

Chapter 1:

Define the following quantities:
Force, torque, pressure, voltage, temperature difference.
Given two or more mechanical forces acting along the same line, determine the resultant force.
Given two of the following quantities in a mechanical rotational system determine the third:
Force, lever arm, torque.
Given two of the following quantities in a fluid system, determine the third:
Force, area, pressure.
Given two of the following quantities in a fluid system, determine the third:
Pressure, height of fluid, weight density of fluid.
Given two or more voltage sources connected in series, determine the resultant voltage.
Given a temperature in celsius, fahrenheit or kelvin determine the equivalent temperature in either other scale.
Describe how pressure in fluid systems, voltage in electrical systems and temperature difference in thermal systems, are similar to force and torque in mechanical systems.
Describe the conditions that must be met for equilibrium in each of the following energy systems:
Mechanical, fluid, electrical, and thermal.
Chapter 1 Problems: 1, 4, 6, 8, 9, 10, 11, 12, 17, 18, 22, and 23.

Chapter 2:

Define work and energy in general terms that apply to any energy system and distinguish work from energy.
Define the following units: of work and energy:
Foot-pound, Newton-meter, Joule, calorie, British thermal unit.
Define the following terms and explain their usefulness in determining work done:
Radian, current, specific heat, heat capacity.
Given two standard quantities in a transnational or rotational mechanical system, or fluid system, determine the third.
Given two of the three electrical parameters determine the third.
Given the temperature difference across a uniform thickness of a substance, the dimensions of the substance and its thermal conductivity, calculate the heat flow through the substance. Knowing two of the following quantities in a thermal system, determine the third:
Temperature change of the object, heat capacity of the object, or work (heat energy transferred).
Define and give examples of latent heat and sensible heat.
State the general equation for work, and explain how it is applied to each of the following energy systems:
Mechanical (translational and rotational), fluid, electrical, and thermal.
Chapter 2 Problems: 2, 3, 5, 6, 9, 12, 16, 17, 21, and 22.

MID TERM EXAM

COURSE SEQUENCE (CONT.)

Chapter 3:

Define and express the basic units, in both English and SI systems of units, where applicable, of the following:
Acceleration, angular velocity and acceleration, volume-flow rate, mass-flow rate, electric current, heat-flow rate.
In a linear mechanical system given all the quantities except one, in each of the following groups, determine the unknown quantity:
Displacement, elapsed time, and velocity.
Initial velocity, final velocity, elapsed time, and acceleration.
Mass, force, and acceleration.
In a rotational system, given all the quantities except one in each of the following groups, determine the unknown:
Angular displacement, elapsed time, and velocity.
Initial angular velocity, final angular velocity, elapsed time, and angular acceleration.
In a fluid system, given all the quantities except one in each of the following groups, determine the unknown quantity:
Volume of fluid moved, elapsed time, volume-flow rate.
Mass of fluid moved, elapsed time, mass-flow rate.
Given two of the following quantities in an electrical system, determine the third:
Charge transferred, elapsed time, current.
Given two of the following quantities in a thermal system, find the third:
Heat energy of transferred, elapsed time, heat flow.
State the general equation for rate and explain how it applies to each of the following energy systems:
Mechanical translational, mechanical rotational, fluid, electrical, thermal.
Chapter 3 problems: 3, 4, 5, 6, 9, 11, 13, 14 or 17, 18, 20, 21, 22

Chapter 5:

Define resistance in a general way and state the final form of the energy expended when a force-like quantity does work to overcome resistance in any energy system.
Calculate the magnitudes of starting and sliding frictional forces, given the mass or weight of the object, coefficients of friction, and angle of incline.
Given two of the following quantities in fluid, electrical, and thermal systems, determine the third:
Force-like quantity, rate, resistance.
Describe the difference in laminar and turbulent flow.
State the factors contributing to: fluid resistance in pipes, electrical resistance in wire, and thermal resistance of objects.
Describe with the use of graphics, the definition of resistance as the ratio of force-like quantity to rate. Include the units of force-like quantity, rate, and resistance for the following systems: fluid, electrical, thermal.
State the fundamental difference between sliding friction and resistance as they apply to the following sy   s: fluid, electrical, thermal.
Chapter 5 problems: 2, 3, 5, 7, 8, 9, 10, 12, 14, 15, 19, 24.
Review and question time

FINAL - 3 HOURS

COURSE OUTLINE

DEPARTMENT:	Technical Education Division
PROGRAM:	
CURRICULUM:	Applied Technology
COURSE TITLE:	Technical Physics 112
COURSE NUMBER:	PHY 112
COLLEGE TRANSFER:	No
TYPE OF COURSE:	Vocational Technical Education
CREDIT HOURS:	5

Lecture Hours	27
Lab Hours	55
Home Work Hours	54
Total Hours	136

CLASS SIZE:	24
COURSE DESCRIPTION:	Continuation of applied physics with accentuation on momentum, energy, power, force transformers, energy converters, transducers, vibrations and waves.
COURSE HISTORY:	Originally developed by: F. W. Busby, January, 1992 Update version developed by: F. W. Busby, May, 1993
PREREQUISITES:	Mat 112, or concurrent registration, PHY 111, or permission of instructor **before** registration.

LEARNING OBJECTIVES:

Momentum

1. Define the following terms, state the appropriate units in the MKS(SI), the CGS, and the English systems and give the defining equation for each:
   Linear momentum, angular momentum, impulse, angular impulse, moment of inertia.

2. Given two of the following quantities, determine the third:
   Mass of an object
   Velocity of the object
   Linear momentum of the object.
3. Given two of the following quantities, determine the third:
   Angular velocity of the object
   Angular momentum of the object
   Moment of inertia of an object.
4. Given all but one of the following quantities describing a linear collision, determine the unknown quantity:

Mass of first object	Mass of second object
Initial velocity of first object	Initial velocity of second object
Final velocity of first object	Final velocity of second object

5. Explain each of the following concepts in a short paragraph:
   Conservation of linear momentum
   Conservation of angular momentum.
6. Use an equation to calculate the force produced on one blade of a reaction turbine, given the velocity of fluid and the mass of fluid per unit time striking the blade.

Potential and kinetic energy

7. Define potential ener , kinetic energy, and conservation of energy by using examples from mechanical systems.
8. Given any two of the quantities in the following groups, determine the third:

Mass	velocity	kinetic energy,
Mass	heights	potential energy,
Spring constant	spring displacement	potential energy,
Moment of inertia	angular velocity	kinetic energy,
Capacitance	voltage	potential energy.

9. Given Bernoulli's equation and the height of liquid in a tank, determine the exit velocity at the bottom of the tank if there is no fluid friction.
10. List and describe the three processes that transfer thermal energy.
11. Discuss the conservation of energy as it applies to fluid, electrical and thermal systems.

Power

12. Define "power" as it applies, in general to all energy systems, and write equations that relate work, elapsed time and rate to power in mechanical, fluid, and electrical systems.
13. List the SI and English units used to define power for each energy system.
14. Given two of the following groups of quantities find the third:

Force-like quantity times displacement-like quantity (Work),	elapsed time,	power,
Force-like quantity,	rate,	power,
Input power,	output power,	efficiency.

15. Define the following terms: input power, output power, efficiency.
16. Convert values for power expressed using one energy unit to equivalent values expressed using any other unit.

Force Transformers

17. Describe specific force transformers in the mechanical translational, mechanical rotational, fluid and electrical systems. Discuss their similarity as transformers of force-like quantities.
18. Define the following terms: ideal mechanical advantage, actual mechanical advantage, efficiency.
19. Calculate the ideal mechanical advantage of a specific pulley, lever, screw, wheel and axle, hydraulic press or lift, and electrical transformer.
20. Calculate the change in current in an ideal electrical transformer.
21. Discuss how the roll of resistance in a transformer dissipates energy input and reduces efficiency.
22. Describe the power input and power output characteristics of a transformer that operates continuously.

Energy Converters

23. Describe energy converters in general terms that apply to all energy conversion devices.
24. Describe the operation of the following energy converters:

Vane pump	Electric generator
Turbine	Electric heater
Internal-combustion engine	Boiler
Solar collector	

25. Given two of the following quantities, determine the third:
    Input energy
    Output energy
    Efficiency.
26. Given the efficiency of all energy converters used in an energy-conversion system, determine the overall system efficiency.

Transducers

27. Define ε transducer, distinguishing between, transducers that require external energy sources and those that do not.
28. Describe the operation of the following transducers:

Strain gage	Accelerometer
Microphone	Turbine flowmeter
Barometer	Meter movement
Thermocoup[illegible]	Thermistor
Photocondu[illegible]/e cell	Photovoltaic cell

COURSE OUTLINE (CONT.)

Vibrations and Waves

29. Distinguish between longitudinal and transverse waves by giving at least two examples of each type and by drawing and labeling a sketch of each.
30. Define the following words associated with waves and wave motion:

Propagating medium	Wavelength
Frequency	Period
Wave speed	Phase
Displacement Amplitude	Constructive interference
Standing wave	Destructive interference.
Beats	

31. Given two of the following, calculate the third:
    wavelength, frequency, speed.
32. Interpret the following equation, and explain each symbol:
    $y = A\sin 6.283(x/\lambda - ft)$
33. Use sine-wave sketches of both current and voltage to explain the meaning of the expression: The current leads the voltage by a given phase.
34. Describe the superposition principal.
35. Describe wave phenomena in each of the following energy systems:
    mechanical, fluid, electrical.

REQUIRED TEXT: Unified Technical Concepts: Physics For Technicians and Lab Book to Accompany Physics for Technicians.
Published by the Center for Occupational Research and Development.

EVALUATION AND GRADING This is a competency based course. This means that for each assignment there is a list of specific skills to be exhibited, as defined in the course outline.

Grading will be based on the following percentages:

Lab Work	36%
Final Exam	32%
Mid Term Exam	16%
Home Work	16%

COURSE SYLLABUS

General Information:

Quarter	WINTER
Course Number:	PHY 112
Course Title:	Technical Physics 112
Section Number:	01 Days, 02 Evenings
Instructor:	Bill Busby
Office Location:	Technical Education
Office Hours:	9:30 am to 6:00 pm, Monday and Wednesday
Office Phone Number:	764-5390
Home Phone:	244-2691
Room Number:	TC 120
Lab Hours:	8:00am to 9:30am, 6:00pm to 9:30pm (Mon & Wed)
Course Description:	Continuation of applied physics with accentuation on momentum, energy, power, force transformers, energy converters, transducers, vibrations and waves.
Required Materials:	Unified Technical Concepts: Physics For Technicians and Lab Book to Accompany Physics for Technicians. Published by the Center for Occupational Research and Development.
Optional Materials:	Lab book to accompany Physics for Technicians
Course Sequence:	Please see attached.
Evaluation Policy:	All grades will be added, 40 points will be subtracted. The difference (0 to 60) will be multiplied by 4.0 and divided by 60. The result is the grade (i.e., 70% - 40 = 30, 30 x 4 = 120, 120/60 = 2.0).
Grading Procedure:	Lab Work = 36 Final Exam = 32 Mid Term = 16 (include Quizzes) Homework = 16
Other Policies:	There will be zero % for any assignment or test where cheating is evident. Make up exams must be arranged for before the exam in question, and will be at the instructors discretion.

COURSE SEQUENCE PHY 112

Chapter 4:

Define the following terms, using the appropriate units in the MKS system, the CGS system and the English system and give the defining equation for each:

Linear momentum	Angular impulse
Angular momentum	Moment of inertia
Impulse	

Given two of the following quantities, determine the third:

Mass of an object
Velocity of the object
Angular momentum of the object.

Given all but one of the following linear collision quantities, determine the unknown value:

Mass of first object	Mass of second object,
Initial velocity of first object	Initial velocity of second object
Final velocity of first object	Final velocity of second object

Explain each of the following concepts in a short paragraph:

Conservation of linear momentum
Conservation of angular momentum.

Use an equation to calculate the force produced on one blade of a reaction turbine, given the velocity of fluid and the mass of fluid per unit time striking the blade.

Chapter 4 problems: all 8.

Chapter 6:

Define: Potential energy, kinetic energy, conservation of energy, by using examples from mechanical systems.

Given any two of the quantities in the following groups, determine the third:

Mass	velocity	kinetic energy,
Mass	height	potential energy,
Spring constant	spring displacement	potential energy,
Moment of inertia	angular velocity	kinetic energy,
Capacitance	voltage	potential energy.

Given Bernoulli's equation and the height of liquid in a tank, determine the exit velocity at the bottom of the tank if there is no fluid friction.

Discuss the conservation of energy as it applies to the following systems:

Fluid, electrical, thermal.

Chapter 6 problems: 2, 3, 5, 6, 10, 13, 16, 18, 20, 21, 22.

Chapter 7:

Define "power" as it applies, in general, to all energy systems and write equations that relate work, elapsed time, force and rate to power in these energy systems:

Mechanical, fluid, electrical.

List the SI and English units to define power for each energy systems.

Given any two of the following quantities in an energy system, determine the third:

Work, elapsed time, power.

COURSE SEQUENCE (CONT.)

Chapter 7 (cont.)

With any two of the quantities in an energy system given, determine the third:
Force-like quantity, rate, power.

Define the following terms:
Input power, output power, efficiency.

Given any two of the following quantities in a energy system, find the third:
Input power, output power, efficiency.

Convert values for power expressed using one energy unit to equivalent values expressed using any other unit.

Chapter 7 problems: 2, 3, 4, 5 or 6, 8, 12, 15, 18, 20, 21.

Chapter 8:

Describe specific force transformers in the following systems:
Mechanical translational, mechanical rotational, fluid, electrical

Define the following terms:
Ideal mechanical advantage, actual mechanical advantage, efficiency.

Calculate the ideal mechanical advantage of the following systems:
Pulley, wheel and axle, lever, hydraulic press or lift, screen, electrical transformer.

Calculate the change in current in an ideal electric transformer.

Discuss how the role of resistance in a transformer dissipates energy input and reduces efficiency.

Describe the power input and power output characteristics of a transformer that operates continuously.

Chapter 8 problems: 3, 7, 11, 15, 16, 18, 19, 20, 21, 24.

Chapter 9:

Describe energy converters in general terms that apply to all energy-conversion systems.

Describe the operation of the following energy converters:

Vane pump	Electric generator
Turbine	Electric motor
Electric Heater	Internal-combustion engine
Boiler	Solar collector

Given two of the following quantities, determine the third:
Input energy, output energy, efficiency.

Given the efficiency of all energy converters used in an energy-conversion system, determine the overall system efficiency.

Chapter 9 problems: 3, 4, 5, 7, 8, 9, 10 , 14, 15, 18, 20, 22.

Chapter 10:

In a short paragraph, define a transducer. Include a distinction between transducers that require external energy sources and those that do not.

Describe the operation of the following transducers:

Strain gage	Accelerometer
Microphone	Turbine flowmeter
Barometer	Meter movement
Thermocouple	Thermistor
Bimetallic strip	Photoconductive cell
Photovoltaic cell	

Chapter 10 problems: All 13.

COURSE SEQUENCE (CONT.)

Chapter 11:

Distinguish between longitudinal and transverse waves by drawing two or more sketches (with labels) of each type.

Define the following words associated with waves and wave motion:

Propagation medium	Wavelength
Frequency	Period
Wave speed	Displacement
Amplitude	Phase
Standing wave	Constructive interference
Beats	Destructive interference

Calculate the wavelength of a wave, given its speed and frequency.

Interpret the following equation, explaining the significance of each symbol:

$$Y = A\sin 2\pi(x/\lambda - ft)$$

Use sine-wave sketches of both current and voltage to explain the meaning of the expression: " The current leads the voltage by a given phase angle".

Describe the superposition principle.

Describe wave phenomena in each of the following energy system:

Mechanical, fluid, electrical.

Chapter 11 problems: 1, 2, 4, 8, 9, 10, 15, 20, 21, 22, 24, 25.

Review and question time.

FINAL - 3 HOURS

COURSE OUTLINE

DEPARTMENT:	Technical Education Division
PROGRAM:	
CURRICULUM:	Applied Technology
COURSE TITLE:	Technical Physics 113
COURSE NUMBER:	PHY 113
COLLEGE TRANSFER:	No
TYPE OF COURSE:	Vocational Technical Education
CREDIT HOURS:	5

Lecture Hours	27
Lab Hours	55
Home Work Hours	54
Total Hours	136

CLASS SIZE:	24
COURSE DESCRIPTION:	Continuation of applied physics with accentuation on time constants, radiation, and optical systems.
COURSE HISTORY:	Originally developed by F.W. Busby, January 1992 Updated version developed by F.W. Busby, May 1993
PREREQUISITES:	MAT 113, or concurrent registration and PHY 112 or permission of instructor **before** registration.

COURSE OUTLINE (CONT.)

LEARNING OBJECTIVES:

Time Constants

1. Define the following terms:

Steady state	Time constant
Transient	Decay constant
Damping	Half-life

2. Draw and label a graph showing an exponentially decaying function showing time constants T1/2 and Ti/e and write an equation for the function on the graph.
3. Given the initial temperature of a hot body, the ambient temperature of its surroundings, and the thermal time constant of the system, determine the temperature of the body after a specified time interval.
4. Given the number of radioactive atoms in a sample and the decay constant, determine the number of atoms remaining after a specified time interval.
5. Given the values of resistance, capacitance, and applied voltage in an RC electrical circuit, determine the time constant for the circuit, the time required for the capacitor voltage to reach 99% of the applied voltage, and the circuit current, and capacitor voltage after a specified time interval.
6. Explain how the concept of time constants can be applied to the following energy systems; give a specific example in each case:

Mechanical transnational	Thermal
Fluid	Optical
Mechanical rotational	Nuclear
Electrical	

Radiation

7. Describe in one or two sentences the basic properties of each of the following types of radiation: sound, light, alpha and beta particles.
8. Define electromagnetic radiation and describe a simple experiment that illustrates how electromagnetic radiation can be created.
9. List the frequencies in the electromagnetic spectrum from long-wave length EM waves of ac power to gamma rays, including each major part:
   Radio, FM, television,
   Radar, microwave, infrared,
   Visible, ultraviolet, X-ray, gamma ray.
10. Given the equation $c = \lambda / f$ (relating wave speed, wavelength, and frequency), determine the radiation frequency for any part of the electromagnetic spectrum.
11. Given the equation $E = hf$ or $E = hc/\lambda$, determine to photoenergy of different parts of the EM spectrum.
12. Describe quantitatively the nature of electromagnetic waves in terms of electric and magnetic fields. Explain what is required to generate EM wave and how it can propagate through empty space.

COURSE OUTLINE (CONT.)

13. Describe a photon and explain why both wave and particulate phenomena are required to explain the interaction of EM radiation and matter.
14. Explain the meaning of the inverse square law with respect to EM radiation.
15. Differentiate alpha, beta, and gamma radiation.
16. Explain polarization and its effect on EM radiation. Define visible radiation in terms of frequency, wavelength and energy.
17. Describe reflection and refraction of EM radiation.

Optical Systems

18. Describe how:
    - Light can be represented by light rays
    - Shadows are formed from point and extended sources.
19. List the four processes that account for all light energy striking a surface.
20. Explain in two of three sentences the purpose and operation of a beam splitter.
21. Define: virtual image, real image, optical axis.
22. State the law of refraction and illustrate it with a diagram.
23. Draw and label ray diagrams that illustrate the position, size and type of image formed with the following:
    - Plane mirrors,
    - Spherical mirr· r⌃,
    - Thin concave lenses.
24. For a spherical mirror or a thin lens, given two of the following quantities determine the third:
    - Focal length,
    - Object distance,
    - Image distance.
25. For a spherical mirror or a thin lens, given three of the following quantities determine the fourth:
    - Object distance,
    - Image distance,
    - Object size,
    - Image size.,
26. State the law of refraction and illustrate it with a diagram.
27. Given three of the following quantities, find the fourth:
    - Angle of incidence,
    - Angle of refraction,
    - Index of refraction of first medium,
    - Index of refraction of second medium.
28. Explain total reflection and the critical angle for its occurrence.

COURSE OUTLINE (CONT.)

29. State the sign convention used when working with optics equations, with respect to the:
    - Direction of travel of light rays,
    - Radii of curvature for convex and concave surfaces,
    - Object distance and orientation for real and virtual images,
    - Image distance and orientation for real and virtual images,
    - Focal length of lens or mirror.
30. Explain how a microscope can be used to measure the index of refraction of a liquid.
31. Draw appropriate diagrams to illustrate the following image-forming systems:
    - Positive lens focal point,
    - Negative lens focal point,
    - The real image formed by a positive lens,
    - The virtual image formed by a positive lens and by a negative lens.
32. Given the radii of curvature of a spherical lens and its index of refraction, calculate the focal length of the lens.
33. Describe:
    - What a diffraction grating is and how it can be used to determine wavelength of a beam of light.
    - How interference patterns can be used to measure small angles and distances.
    - The process of stimulated emission.
34. List and give the purpose of the three elements of a laser.
35. State the properties of laser radiation when the laser operates in a single axial mode.
36. Explain how the distance to the moon can be measured by using a pulsed laser.
37. Describe how the human eye forms an image of an object on the retina.
38. Use light rays to describe the action of a nearsighted eye and farsighted eye.
39. Calculate the size of an image in the retina given the:
    - Size of the object,
    - Distance from the lens of the eye to the object,
    - Distance from the lens to the retina.
40. Show how to use a lens to correct for nearsighted or farsighted vision.
41. Explain how a simple microscope or magnifying glass increases the image size on the retina.
42. Calculate the magnification of a simple microscope.
43. Use light rays to show how a camera forms an image on a film.
44. Calculate the normal focal length for a camera from the film size.
45. Explain how a beam expander works.
46. Draw a diagram of a Michelson interferometer.
47. Explain how a Michelson interferometer can be used to measure wavelength distances.
48. Explain how a spectrophotometer may be used to determine the transmission of a sample at a particular wavelength.

COURSE OUTLINE (CONT.)

REQUIRED TEXT:

Unified Technical Concepts: Physics For Technicians and Lab Book to Accompany Physics for Technicians. Published by the Center for Occupational Research and Development.

Evaluation and Grading.
This is a competency based course. This means that for each assignment there is a list of specific skills to be exhibited, as defined in the course outline.

Grading will be based on the following percentages:

Lab Work	36%
Final Exam	32%
Mid Term Exam	16%
Home Work	16%

COURSE SYLLABUS

General Information:

Quarter:	SPRING
Course Number:	PHY 113
Course Title:	Technical Physics 113
Section Number:	01 Days, 02 Evenings
Instructor:	Bill Busby
Office Location:	Technical Education
Office Hours:	9:30 am to 6:00 pm, Monday and Wednesday
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Lab Hours:	8:00am to 9:30am, 6:00pm to 9:30pm Evenings
Course Description:	Continuation of applied physics with accentuation on time constants, radiation, and optical systems.
Required Materials:	Unified Technical Concepts: Physics For Technicians and Lab Book to Accompany Physics for Technicians. Published by the Center for Occupational Research and Development.
Optional Materials:	Lab book to accompany Physics for Technicians
Course Sequence:	Please see attached.
Evaluation Policy:	All grades will be added (100 max). 40 points will be subtracted from the total. The difference (0 to 60) will be multiplied by 4.0 and divided by 60. The result is the grade (i.e. 70% - 40 = 30, 30 x 4 = 120, 120/60 = 2.0).
Grading Procedure:	Lab Work = 36 Final Exam = 32 Mid Term = 16 (include Quizzes) Homework = 16
Other Policies:	There will be zero % for any assignment or test where cheating is evident. Make up exams must be arranged for before the exam in question, and will be at the instructors discretion.

COURSE SEQUENCE PHY 113

Chapter 12:

Define the following terms:

Steady state	Transient
Damping	Time constant
Half life	Decay constant

Draw and label a graph showing an exponentially decaying function. Include on the graph the time constants T1/2 and Ti/e = T. Also, write an equation for the function shown on the graph.

Given three if the following conditions determined the fourth:
Initial temperature of a hot body,
Ambient temperature of its surroundings,
Thermal time constant of the system,
Temperature after a specified time interval.

Given two of the following conditions, determine the third:
Number of radioactive atoms in a sample,
Decay constant,
Number of atoms remaining after a given specified time interval.

In a RC electric circuit, give the values for: resistance, capacitance, and applied voltage.

Determine the following values:
Time constant for the circuit,
Time required for the capacitor to charge to 99% of the applied voltage,
Circuit current after a specified time,
Capacitor voltage after a specified time.

Explain how the concept of time constants can be applied to the following energy systems, and give a specific example of each case:

Mechanical translational	Mechanical rotational
Fluid	Electric
Thermal	Optical
Nuclear	

Chapter 12 problems: 1, 3, 4, 5, 8, 12, 13, 18, 19, 21, 23.

Chapter 13:

Briefly describe the basic properties of each of the following types of radiation: sound, light, alpha particles, beta particles, gamma rays.

Define electro magnetic radiation and describe a simple experiment that illustrates the creation of electromagnetic radiation.

List the electromagnetic (EM) spectrum frequencies from long-wavelength EM waves of AC power to the x-ray/gamma radiation overlap. Include each major part, including radio, FM broadcast, television, radar, microwave, infrared, visible, ultraviolet x-ray, and gamma ray.

Determine the radiation frequency for any part of the EM spectrum, given the relation relating equation $C = \lambda f$, for the following: wave speed, wave length, frequency.

Determine the photon energy of different parts of the EM spectrum given the equation:
$E = hf$ or $F = hc/\lambda$ ($f\lambda = c$).

COURSE SEQUENCE PHY 113 (CONT.)

Describe qualitatively the nature of an EM wave in terms of electric and magnetic fields
State what is always required to generate EM waves.
Explain how EM waves are propagated through empty space without benefit of a conductive medium.
Describe a photon and explain why both wave and particle-like phenomena are required to describe interaction of EM radiation with matter. Give examples in which the wave character is most useful in describing EM radiation and in which the photon character is most useful.
Explain the inverse-square law and how this law is used to describe the decrease in intensity of EM radiation as it propagates away from a source.
Define polarization and explain what is meant by polarized EM radiation in particular polarized light.
Define visible radiation and determine its numeric limits in terms of: wavelength, frequency, energy.
Describe the reflection and refraction of light and a setup to experimentally verify the two laws.
Differentiate between the nuclear energy release in the forms of: alpha, beta, and gamma.
Briefly explain each of the three parts in the symbol:

$$92^{U^{238}}$$

Given the appropriate equipment, illustrate and verify the inverse-square law of EM radiation in the visible light spectrum.
Given the appropriate equipment, produce and detect polarized radiation.
Chapter 13 problems: All odd numbered.

Chapter 14:

Describe how:
Light can be represented by light rays,
Shadows are formed from point and extended sources.
List the four processes that account for all light energy striking a surface.
Explain in two or three sentences the purpose and operation of a beam splitter.
Define: virtual image, real image, optical axis.
State the law of refraction and illustrate it with a diagram.
Draw and label ray diagrams that illustrate the position, size and type of image formed with the following:
Plane mirrors,
Spherical mirrors,
Thin concave lenses.
For a spherical mirror or a thin lens, given two of the following quantities determine the third:
Focal length,
Object distance,
Image distance.
For a spherical mirror or a thin lens, given three of the following quantities determine the fourth:
Object distance,
Image distance,
Object size,
Image size.

COURSE SEQUENCE PHY 113(CONT.)

State the law of refraction and illustrate it with a diagram.
Given three of the following quantities, find the fourth:
Angle of incidence,
Angle of refraction,
Index of refraction of first medium,
Index of refraction of second medium.
Explain total reflection and the critical angle for its occurrence.
State the sign convention used when working with optics equations, with respect to the:
Direction of travel of light rays,
Radii of curvature for convex and concave surfaces,
Object distance and orientation for real and virtual images,
Image distance and orientation for real and virtual images,
Focal length of lens or mirror.
Explain how a microscope can be used to measure the index of refraction of a liquid.
Draw appropriate diagrams to illustrate the following image-forming systems:
Positive lens focal point,
Negative lens focal point,
The real image formed by a positive lens,
The virtual image formed by a positive lens and by a negative lens.
Given the radii of curvature of a spherical lens and its index of refraction, calculate the focal length of the lens.
Describe:
What a diffraction grating is and how it can be used to determine wavelength of a beam of light.
How interference patterns can be used to measure small angles and distances.
The process of stimulated emission.
List and give the purpose of the three elements of a laser.
State the properties of laser radiation when the laser operates in a single axial mode.
Explain how the distance to the moon can be measured by using a pulsed laser.
Describe how the human eye forms an image of an object on the retina.
Use light rays to describe the action of a nearsighted eye and farsighted eye.
Calculate the size of an image in the retina given the:
Size of the object,
Distance from the lens of the eye to the object,
Distance from the lens to the retina.
Show how to use a lens to correct for nearsighted or farsighted vision.
Explain how a simple microscope or magnifying glass increases the image size on the retina.
Calculate the magnification of a simple microscope.
Use light rays to show how a camera forms an image on a film.
Calculate the normal focal length for a camera from the film size.
Explain how a beam expander works.
Draw a diagram of a Michelson interferometer.
Explain how a Michelson interferometer can be used to measure wavelengths or distances.
Explain how a spectrophotometer may be used to determine the transmission of a sample at a particular wavelength.
Chpater 14 problems: 2 3, 4, 6, 9, 11, 13, 15, 16, 17, 22, 24, 33, 38, 40, 42, 43, 45, 46, 48, 52, 56, 57.
Reveiw and question time. **FINAL - 3 HOURS**