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ABSTRACT

The project described in this report was conducted at the Community College of Luzerne County (Pennsylvania) to develop, in conjunction with area vocational-technical schools, the second year of a competency-based curriculum in laser/electro-optics technology. During the project, a task force of teachers from the area schools and the college developed courses and competencies for both secondary and postsecondary laser/optics programs. The task force also developed materials and equipment lists, supervised the layout of the laboratory in a new Advanced Technology Center, created a competency-based catalog of proposed courses, and implemented the program. Most of this document consists of the curriculum materials, including competencies for four courses in laser/electro-optics technology, recommendations for equipment/software selection, and recommendations for articulation. Attachments include a list of task force members, task force data and recommendations, the Advanced Technology Center brochure, a program brochure, specifications for two laboratories, and information on use of a laser laboratory for technical physics. (KC)

FINAL REPORT

DEVELOPMENT OF ARTICULATED COMPETENCY-BASED CURRICULUM IN LASER/ELECTRO-OPTICS TECHNOLOGY
CONTRACT NUMBER [redacted]

Wesley E. Franklin, Project Director
Regina Antonini, Project Coordinator

Community College of Luzerne County

Nanticoke, Pennsylvania 18634

September 30, 1988

PENNSYLVANIA DEPARTMENT OF EDUCATION
BUREAU OF VOCATIONAL AND ADULT EDUCATION
CURRICULUM AND PERSONNEL DEVELOPMENT SECTION

TABLE OF CONTENTS

Attachment #5 - Equipment Specifications

1. Laser/Electro-Optics Laboratory Accessories and Components.

2. Laser/Electro-Optics Lab -- Major Equipment

Attachment #6 - Special Considerations for Laser Lab

Attachment #7 - Use of Laser Lab for Technical Physics

Luzerne County Community College
PROSPECT STREET AND MIDDLE ROAD ● NANTICOKE, PENNSYLVANIA 18634

ACKNOWLEDGEMENTS

The completion of thi' curriculum development project was made possible through the hard work, diligence, and cooperation of the following, listed in alphabetical order:

Regina Antonini	Director, Community-Based and Institutional-Based Special Programs and Task Force Coordinator
Elaine Brown	Assistant to the Project Director
Patrick J. Santacroce	Executive Director, Institute for Developmental Educational Activities
Elizabeth Yeager	Coordinator, Customized Job Training and Task Force Coordinator
Stephen Yokimishyn	Director, BIE Partnership

The work of the Curriculum Development Task Force (see Attachment #1 for a list of their names and institutions) also merits special recognition. Their cooperrtion and expertise have greatly facilitated the secondr y/post-secondary partnership and articulation that have resulted from this project.

A special note of appreciation is due Mr. Thomas J. Moran, President of the Community College of Luzerne County. His interest and support were very important in pursuing the project to a successful completion.

Wesley E. Franklin
Project Director and
Executive Director, Advanced Technology Center
September 30, 1988

SECTION I:

ABSTRACT
AND
FINANCIAL SUMMARY

ABSTRACT

85-8027: Development of Articulated Competency-Based Curriculum in Laser/Electro-Optics Technology.

Regina Antonini
Community College of Luzerne County
Prospect Street and Middle Road
Nanticoke, PA 18634

$37,306 Federal
7/1/87 to 6/30/88

The purpose of this project was to develop, in cooperation with area vocational-technical schools, the second year of a competency-based curriculum in laser/electro-optics technology.

OBJECTIVES

1. Develop courses and competencies for second year of program, both secondary and post-secondary.

2. Develop equipment lists and instructional materials for second year both secondary and post-secondary.

3. Review all developed materials and lists (by Task Force).

4. Layout Laser lab in new Advanced Technology Center and develop plan to integrate proposed laser equipment into secondary school physics and AVTS electronics labs.

5. Integrate laser/electro-optics courses and competencies, using V-TECS model, into one unified competency-based catalog.

6. Prepare and review first draft of final report.

7. Publish and disseminate final report.

OUTCOMES

1. Task force membership was continued from previous year, with addition of four science and math teachers from four area school districts and several faculty from LCCC science and engineering technology departments. Task force met periodically and prepared advanced placement competency testing, reviewed proposed textbooks, and reviewed proposed second year program.

2. New staff for new programs were incorporated into task force and prepared detailed equipment specifications for use in competitive bid process.

3. Construction of new advanced technology center was monitored, and task force along with secondary school guidance counselors toured new facility in April and May, 1988.

4. Changes in lab layouts and specifications were made as a result of task force recommendations.

5. Second year of competency-based curriculum was approved by task force, College Senate, and President Moran, and included in 1988-89 College Catalog.

6. Program was implemented and began accepting enrollments for the 1988 Fall Semester.

7. Final report was completed and distributed to task force, AVTS's, private sector participants, and appropriate agencies.

FINANCIAL SUMMARY

LUZERNE COUNTY COMMUNITY COLLEGE
LASER/ELECTRO-OPTICS TECHNOLOGY
CURRICULUM MATERIALS DEVELOPMENT
1987-1988

LASER/ELECTRO-OPTICS TECHNOLOGY

	APPROVED	EXPENDED	BALANCE
SALARIES	- 19363.00	12212.95	7150.05
BENEFITS	- 6777.00	3211.10	3565.90
HONORARIA	- 6400.00	9186.67	-2786.67
SUPPLIES/ - COMM	- 400.00	2663.00	-2263.00
PRINTING	- 500.00	274.15	225.85
TRAVEL	- 426.00	726.07	-300.07
AUDIT	- 677.00	0.00	677.00
INDIRECT COST	- 2763.00	2261.92	501.08
TOTAL	- 37306.00	30535.86	6770.00

SECTION II:

PROJECT APPROACH/ METHODOLOGY

METHODOLOGY

This curriculum materials development project began in 1986-87 and continued in 1987-88 with the assistance of a task force whose membership included representatives from the five area vocational-technical schools: Hazleton, Lackawanna, Monroe, West Side and Wilkes-Barre (see ATTACHMENT #1). In the initial grant proposal, the stated plan was to use vo-tech faculty (task force) to assist in curriculum development and in identification of equipment and facilities needed for the program. After several meetings with the task force during the fall semester, this approach did not appear to be feasible because of time and expertise limitations -- most of the members of the task force taught evening courses as well as teaching full-time during the day. Also, because the proposed program is a new technology, there was a significant amount of research that had to be done, both for the college and the task force.

For these reasons, it was decided to use expertise already available, namely consultants, and have the task force function in a review/reaction mode once there were materials/reports from the consultant to consider. This way, the task force's knowledge of the local educational and industrial training requirements could be used to make appropriate changes in the consultant's reports and recommendations so the proposed program would be in line with the needs of the college's service area. Also, representatives of the college's engineering and science departments, administration, and from the private sector were able to participate in the process and provided valuable input throughout. This process was continued during 1987-88.

ATTACHMENT #2 summarizes the work of the Task Force regarding program changes, textbook reviews, and advanced placement testing for certain first-year courses. Because this task force was integrated with other task forces for certain aspects of the curriculum development project, this attachment presents an integrated perspective.

Also, one of the results of the task force's review process was the recommendation that the best articulation procedure would be one which provided advanced placement for competencies and/or knowledge rather than attempt to integrate a secondary with a post-secondary curriculum, trying to fit the student in wherever he or she happened to be on the competency continuum. The consultant agreed with this recommendation and included a separate section on articulation in his report. This report is included under SECTION III, which provides a total program report.

ANALYSIS/EVALUATION

The proposed second-year program, along with a revised equipment and facilities plan, were first evaluated by the task force. The task force made several recommendations to the consultants, which were incorporated into the final documents. These documents were then reviewed and approved by the appropriate college administrators, the College Senate, and President Moran.

DISSEMINATION

Copies of the final report will be distributed to the following:

Bureau of Vocational and Adult Education, PDE

Area Vocational-Technical Schools

Private Sector participants

Members of Task Force

Consultants

Ben Franklin Partnership

Pennsylvania Economic Development Partnership

Economic Development Council of Northeastern Pennsylvania

This is the final year of a two-year project and includes the complete curricular program. This program has been implemented in the college's new Advanced Technology Center, see ATTACHMENT II, for the 1988 Fall Semester.

S E C T I O N III:

P R O J E C T S U M M A R Y

LASER/ELECTRO-OPTICS (LEO) TECHNOLOGY CURRICULUM

(Two Year Program of Study)

LUZERNE COUNTY COMMUNITY COLLEGE

Nanticoke, Pennsylvania 18634

June, 1988

TABLE OF CONTENTS

LASER/ELECTRO-OPTICS TECHNOLOGY CURRICULUM

General Business/Industry Trends

The use of Electro-Optical Laser Technology, both in industry and in research has shown dramatic growth in the past 10 years. Some studies have indicated the need for 360,000 laser technicians nationally by 1990. High technology industries tend to congregate in certain geographical areas. A recent report indicated that 83% of high technology manufacturing employment is located in only 24 states.[1] Because the laser industry is developing most rapidly in the heavily populated areas of the East Coast and West Coast, these sections of the country appear to have the greatest employment opportunities in the near future. However, excellent employment opportunities are now becoming evident in midwestern areas such as Chicago, Minneapolis, Milwaukee and Detroit.

The starting salary for electro/optic-laser technicians ranges from $15,600 to $18,200 per year in the metropolitan Philadelphia area. Salaries for experienced technicians average approximately $26,000 per year depending upon background and experience.

Since Luzerne County Community College has an Electrical-Electronics Technology program, the development of a laser program becomes a natural progression in curriculum development.

[1] The State Role in Implementing a High Technology Program. National Workshop on High Technology Careers. John H. Lloyd, St. Louis, Missouri, December 2, 1982.

A laser technology program introduces an educational program that surpasses the traditional offering This new program will be a service to that portion of the population that currently is not being served; i.e., electronics technicians, junior engineers, and other working professions. A more in-depth analysis of this technology is presented below. The following materials discuss educational requirements, employment outlook, Philadelphia area employment (because it was readily available and represented the largest employment area in Pennsylvania), national salaries, benefits and working conditions, and advancement opportunities.

LASER TECHNICIAN
D.O.T. #: 019,181-101

Educational Requirements:

The skills of high technology are acquired by developing an understanding of the physical sciences and how they are applied. A total "systems" approach is emphasized including knowledge of applied physics. Students interested in high tech careers should study core courses in high school and then complete their education at a community college or technical school. This allows students to move from high school to post-secondary school without duplicating courses.

Employment Outlook:

Laser technology is a "high tech" field. It is one of the jobs of the future and has a very good employment outlook. Studies indicate that 360,000 industrial laser process technicians will be needed in the United States by 1990.

Philadelphia Area Employment:

Applications of laser technology are relatively new. Users of lasers can be found in the following industries: construction and excavation; machining and materials working; communications; surveying; testing and measurement; data processing; photo optics; medicine and surgery; military; clothing manufacturing; and research and development.

The potential uses for laser technology are considerable. They are already being used in supermarket checkout counters, gyroscopes to aid navigation, film animation, information transmission, printing, and other areas. Show business uses lasers to entertain audiences by creating color, patterns, and movement to accompany music.

Refer to your local "Yellow Pages" under "Lasers" for listings of possible employers in your area.

Most laser manufacturing firms are located in California -- in the famous "Silicon Valley" area and in southern California. Others are located in metropolitan Boston (Massachusetts).

Salaries/Wages - 1987:

Phila. Area Avg. Starting Salary:	$15,600 to $18,200/yr.
Phila. Area Average Salary:	$23,400 to $28,400/yr.
Maximum Salary:	$33,800/yr.

ALL ENGINEERING TECHNICIANS

National Average Annual Salaries - 1986:

Engineering Technicians	1 yr. exp.	$16,881/yr.
Engineering Technicians	2-3 yrs. exp.	$20,312-$23,896/yr.
Engineering Technicians	4-5 yrs. exp.	$28,412-$32,718/yr.

Benefits, Working Conditions, Advantages & Disadvantages:

1. Some laser technicians work in laboratory-like conditions. Others are employed at construction sites, manufacturing plants, hospital operating rooms, and others.
2. Working conditions are good.
3. Most work a five day, 40 hour week.
4. The usual benefits are available: health and life insurance, paid holidays and vacations, sick leave, etc. Some employers provide their employees with paid prescription, optical and dental plans.
5. Laser technicians often work as part of a team, sometimes with scientists and engineers.

Disadvantages:

1. The training program for laser technicians is difficult.
2. The work can be dangerous if safety procedures are not followed. Power supplies for many lasers involve high voltages. Direct exposure to a laser beam is a possible source of danger.
3. Special goggles are worn when working around lasers.

Advancement Opportunities:

Laser technicians*, with experience and ability, can advance to laser technologists**. Some become field laser technicians, working outside of the laboratory in business settings, hospitals and other sites where lasers are used.

*Generally requires a two-year college degree or equivalent.
**Generally requires a four-year college degree or equivalent.

LASER/ELECTRO-OPTICS (LEO) TECHNOLOGY

Recommended Program of Studies
Leading to the A.A.S. Degree

The theory and applications of Laser/Electro-Optics technology is emphasized in this program. A broad based knowledge of electronics, optics, and lasers is required for competency in this emerging technology. The purpose of the program is to prepare graduates for entry-level positions in industry, business, and government, for assignments such as laser operator, laser technician, and electro-optical sales.

The program is sufficiently comprehensive to allow graduates the opportunity to transfer to other institutions to pursue advanced studies.

First Semester

	Credits
Introduction to Lasers LEO 101	4
Technical Mathematics I MAT 111	5
D.C. Electricity IEL 131	4
English Composition I ENG 101	3
	16

Second Semester

	Credits
Laser Optics LEO 102	4
Technical Mathematics II MAT 112	5
A.C. Electricity IEL 132	3
Technical Physics I PHY 123	4
	16

Third Semester

Course	Credits
Laser Equipment and Measurements LEO 201	4
Electronic Devices IEL 135	3
Technical Physics II PHY 124	4
Fundamentals of Speech SPE 125	3
Introduction to Computer Programming GET 234	3
	17

Fourth Semester

Course	Credits
Laser Applications and Projects LEO 202	4
Digital Circuits IEL 205	3
Social Science Elective	3
Technical Report Writing ENG 261	3
Electronic Amplifier Circuits IEL 201	3
Health/Physical Education HPE	1
	17

LASER/ELECTRO-OPTICS TECHNOLOGY PROGRAM COMPETENCIES

This program is designed to meet the needs in the areas of Medicine and Surgery, Specialized Materials, Medical Devices and Scientific Instrumentation, Communications Services and Equipment, Construction, and Manufacturing.

Electro/Optics Laser technicians are trained in electricity, electronics, mechanical, optical, fluid, thermal, and optical hardware. Laser technicians must understand the properties and principles of lasers, mirrors, light sources, and power supplies. Upon successful completion of this program the technician must be able to:

*** operate laser systems.

*** troubleshoot and repair lasers.

*** operate interferometers, spectrometers, monochromators, and spectrophotometers.

*** operate and calibrate photodetectors, photomultipliers, optical power meters, and calorimeters.

*** fabricate and assemble components for laser/electro-optic devices.

*** troubleshoot and repair electro-optic devices.

*** produce and reconstruct holograms.

*** perform optical inspections and cleaning of optical components.

*** maintain a laboratory notebook, perform data reduction, and prepare reports.

*** prepare and read shop drawings and schematics.

*** perform tests and measurements using electronic devices.

Laser technicians can be found in many industries. In hospitals, they maintain and adjust the intensity and depth of the laser beam penetration for surgical procedures. The technician couples the laser to a robot in automated manufacturing for welding, drilling and cutting metal. The lasers in supermarkets and libraries are serviced by laser technicians.

Technicians may be involved in laser assembly and production; maintenance and operation; troubleshooting and repair; research and development; or sales and service in a number of areas.

Course Competencies For:

1. Introduction to Lasers - LEO 101 — 4 credits, 3 lect., 2 lab.

2. Course Description: This course presents an overall view of laser properties, principles of operation and safety. The theory of light and laser operation concludes with an in-depth study of the Helium-Neon low power gas laser.

   Suggested Audience: Laser/Electro-Optics Students.

   Co-requisites: Math 111, IEL 131

3. Course Competencies/Behavioral Objectives

   Competency 1: Elements and Operation of a Laser. In order to attain this competency, the student should be able to:

   1.1 Define the properties of laser light.

   1.2 Describe the process of stimulated emission.

   1.3 Draw the basic elements of several types of lasers.

   1.4 List the safety precautions for operating low powered lasers.

   1.5 Operate a helium-neon laser safely.

   1.6 List safety precautions applicable to all types of lasers.

   1.7 Determine the power of a laser beam.

   1.8 Understand the use of a photoelectric power meter.

   1.9 Indicate how the eye can be damaged by laser emissions.

1.10 Describe the types of reflection and determine the eye hazards involved.

Competency 2: Properties of Light-Emission and Absorption of Light. In order to attain this competency, the student should be able to:

2.1 Define frequency, wave length, period, phase, and polarization.

2.2 Sketch and label a plane-polarized electromagnetic wave.

2.3 Explain the significance of Brewster's angle.

2.4 Calculate and measure Brewster's angle given the index of refraction.

2.5 Sketch plane and spatial wave fronts.

2.6 Understand temporal and spatial coherence.

2.7 Measure wavelengths using a grating spectroscope.

2.8 Determine the wavelength, frequency, and energy of a photon.

2.9 Describe the stimulated emission of a photon by an atom.

2.10 Explain Doppler broadening of a spectral line.

2.11 Observe and compare the absorption spectra of Nd:YAG and Nd:glass.

Competency 3: Lasing Action - Optical Cavities and Modes of Operation. In order to attain this competency, the student should be able to:

3.1 Explain absorption coefficient.

3.2 Understand the exponential law of absorption.

3.3 Given the optical density of a filter, calculate its transmission.

3.4 Explain normal population distribution and inversion.

3.5 Sketch gain vs. wavelength for a typical laser emission line.

3.6 Draw the energy-level diagram of a laser.

3.7 Measure the transmission of colored filters at the HeNe laser wavelength.

3.8 Draw a diagram of an optical cavity.

3.9 Explain the loss in an optical cavity.

3.10 Determine the gain and output power as a function of time for CW and pulsed lasers.

3.11 Discuss the advantages and disadvantages of different laser cavities.

3.12 Illustrate the longitudinal modes in a typical laser system.

3.13 Clean and align an open cavity HeNe laser.

Competency 4: Temporal and Spatial Characteristics. In order to attain this competency, the student should be able to:

4.1 Define pulse duration, repetition rate, and peak power.

4.2 Define normal, Q-switched, and mode locked laser pulses.

4.3 Graph amplifier gain, loop gain, and power vs. time in a Q-switched laser.

4.4 Explain mode-locking.

4.5 Determine frequency bandwidth of laser output.

4.6 Determine longitudinal coherence length.

4.7 Measure the temporal output characteristics of a repetitively pulsed laser.

4.8 Sketch some transverse electromagnetic modes of a laser.

4.9 Draw and label the irradiance of the TEMoo mode as a function of beam width.

4.10 Explain the significance of the TEMoo mode in lasers.

4.11 Calculate diffraction-limited beam divergence.

4.12 Determine beam divergence angle.

4.13 Explain the near field and the far field of a laser.

4.14 Measure transmission through a calibrated aperture.

Competency 5: The Helium-Neon Lasers and Others. In order to attain this competency, the student should be able to:

5.1 Explain the energy transfer process.

5.2 Describe superradiant lasing.

5.3 Calculate the helium and neon gas pressures for maximum power output.

5.4 Draw a voltage versus current curve for a HeNe laser.

5.5 Explain the failure mechanisms of HeNe lasers.

5.6 Understand the operation of various lasers including HeNe, Argon, CO_2, Ruby, Nd:YAG, etc.

5.7 Discuss operating efficiency of several lasers.

5.8 List the types of gases used as the active media of lasers.

5.9 Discuss applications of semiconductor lasers.

Recommended Course Textbooks:

Introduction to Lasers

Laser/Electro-Optical Technology Services Vol.1

Center for Occupational Research & Development

Methods of Evaluation:

How will the grade for the course be computed:

Tests	60%
Laboratory	20%
Homework/Final	20%

Attendance Requirements:

Students are expected to adhere to the attendance requirements that are delineated in the college catalog.

Safety Considerations:

Students are urged to dress appropriately, exercise caution in the laboratory, and wear eye protection when recommended.

Summary of Topics/Course Outline:

	Chapter	Weeks
Elements and Operation of a Laser	1	1
Elements and Operation of an Optical Power Meter	2	1
Introduction to Laser Safety	3	1
Properties of Light	4	2
Emission and Absorption of Light	5	1
Lasing Action	6	1.5
Optical Cavities and Modes of Operation	7	1.5
Temporal Characteristics of Lasers	8	1
Spatial Characteristics of Lasers	9	1
Helium-Neon Gas Laser - A Case Study	10	1
Laser Classifications and Characteristics	11	2
Review		1

Course Competencies For:

1. <u>Laser Optics - LEO 102</u>

4 Credits
3 lect., 2 lab.

2. Course Description: The geometrical ray nature of light through mathematical and graphical methods forms the first half of this course. Reflection, refraction, and propagation of light from the viewpoint of wave optics is studied in the second half of this course. Holography is the final topic.

Suggested Audience: Laser/Electro-Optics Students

Pre-requisites: Introduction to Lasers

3. Course Competencies/Behavioral Objectives

Competency 1: Geometrical Optics. In order to attain this competency, the student should be able to:

1.1 Define the properties of light rays.

1.2 Trace the path of light rays at plane and spherical surfaces.

1.3 Predict the direction of reflection of light rays on plane and spherical surfaces.

1.4 Experimentally verify the law of reflection.

1.5 Understand the principles of refraction.

1.6 Define the relative and absolute index of refraction.

1.7 Understand color dispersion.

1.8 Using the graphical ray tracing technique, determine the refraction angle at plane and spherical surfaces.

Competency 2: Optical Systems and Components. In order to attain this competency, the student should be able to:

2.1 Define a thin lens, converging lens and diverging lens through a series of sketches.

2.2 Identify the following lens: equi and plano convex, positive and negative meniscus, equi and plano concave.

2.3 Determine analytically, graphically, and experimentally the primary and secondary focal points of various lenses.

2.4 Diagram and define field stop and aperture stop.

2.5 Identify the exit pupil, the entrance pupil, and aperture stop for two lenses analytically and graphically.

2.6 Illustrate the principle of a simple magnifier.

2.7 Calculate lateral and angular magnification.

2.8 Understand the working principle of a compound microscope.

2.9 Draw two different types of laser beam expanding collimators.

2.10 Outline a ray tracing procedure for an optical system.

Competency 3: Fundamentals of Light. In order to attain this competency, the student should be able to:

3.1 Describe a point source of light.

3.2 Measure the irradiance of a point source of light.

3.3 Identify different types of spectra.

3.4 Using a spectral source, produce line, band, and continuum spectra.

3.5 Differentiate between radiometry and photometry.

3.6 Plot the standard luminosity curve and explain.

3.7 Convert between spectral photometric and spectral radiometric quantities.

3.8 Measure irradiance and illuminance for a HeNe laser.

Competency 4: Wave Nature of Light - Reflection and Refraction. In order to attain this competency, the student should be able to:

4.1 Distinguish between geometrical and wave optics.

4.2 Explain wave parameters including wavelength, frequency, wave number, and wave speed.

4.3 Understand and explain Huygen's principle.

4.4 Apply Huygen's principle to develop by construction both reflected and refracted plane waves.

4.5 State the laws of reflection and refraction.

4.6 Discuss Fresnel's equation for the percentage of light reflected from a di-electric surface.

4.7 Test the law of reflection and refraction at a di-electric interface.

Competency 5: Attenuation of Light. In order to attain this competency, the student should be able to:

5.1 Discuss laser propagation through the atmosphere.

5.2 Define beam irradiance, absorption coefficient, transmittance, and optical density.

5.3 Measure the transmittance of a laser beam through a material and determine absorption coefficient.

5.4 Define scattering mechanisms; in particular Raleigh, Mie, and diffraction scattering.

5.5 Demonstrate an understanding of interference.

5.6 Explain the importance of coherence in the interference process.

5.7 Understand the meaning of diffraction.

5.8 Distinguish between Fraunhofer and Fresnel diffraction.

5.9 Sketch several Fraunhofer diffraction patterns.

5.10 Explain the meaning of Raleigh's criterion for determining the limit of resolution.

5.11 Define diffraction-limited optics.

5.12 Produce the far field diffraction pattern of a laser beam due to several different openings.

Competency 6: Polarization and Holography. In order to attain this competency, the student should be able to:

6.1 Understand the difference between natural and polarized light.

6.2 Define linear, circular, and elliptical polarization of light.

6.3 Discuss methods for producing polarized light.

6.4 State the law of Malus.

6.5 Describe the effect of wave retarders or wave converters on polarized light.

6.6 Determine the state of polarization of light of unknown polarization.

6.7 Draw an experimental arrangement that can be used to produce a transmission hologram of a three-dimensional object.

6.8 Make a hologram of a three-dimensional object, develop the film, and reconstruct the virtual image.

Recommended Course Textbooks:

Geometrical Optics

Laser/Electro-Optical Technology Series Vol. 2

Center for Occupational Research & Development

Light Sources and Wave Optics

Laser/Electro-Optical Technology Series Vol. 5

Center for Occupational Reserach & Development

Methods of Evaluation:

Tests
Laboratory
Homework/Final

Attendance Requirements:

Students are expected to adhere to the attendance requirements that are delineated in the college catalog.

Safety Considerations:

Students are urged to dress appropriately, exercise caution in the laboratory, and wear eye protection when recommended.

Summary of Topics/Course Outline:

	Chapter	Weeks
Reflection and Ray Tracing	2-1	1
Principles of Refraction	2-2	1
Refraction and Ray Tracing	2-3	0.5
Imaging With a Single Lens	2-4	1
Imaging With a Multiple Lens	2-5	0.5
F-Stops and Apertures	2-6	0.5
Optical Systems	2-7	1
Matrix Optics	2-8	1
Light Sources and Their Characteristics	5-1	1
Radiometry and Photometry	5-2	1
Wave Nature of Light	5-3	1
Reflection and Refraction	5-4	1
Propagation	5-5	1
Interference	5-6	1
Diffraction	5-7	1
Polarization	5-8	1
Holography	5-9	0.5

Course Competencies for:

1. <u>Laser Measurement and Equipment - LEO 201</u> 4 Credits
3 lect., 2 lab.

2. Course Description: The theory and operation of specialized equipment used to measure laser parameters is studied. Calibration procedures, measurements, and Q switching are also explained.

   Suggested Audience: Laser/Electro Optics Students

   Prerequisites: Introduction to Lasers and Laser Optics

3. Course Competencies/Behavioral Objectives

   Competency 1: Tools of technology - support hardware and components. In order to attain this competency, the student should be able to:

   1.1 Demonstrate a knowledge of optical benches and tables.

   1.2 Use an optical axis established by a laser beam, align an optical bench parallel to the optical axis.

   1.3 Measure the frequencies of the vertical and horizontal vibrations in an optical table.

   1.4 Identify the different types of components mounts.

   1.5 Use a differential - screw micrometer translater and a piezoelectric translater.

   1.6 Reflect and focus the diffracted beam of a specific wavelength onto a target accurately.

   Competency 2: Precision optical components. In order to attain this competency, the student should be able to:

2.1 Understand the characteristics, quality, and finish of optical materials used in windows.

2.2 Examine optical surfaces using a coherent light beam and evaluate their finish by observing scattered light.

2.3 Discuss the limitations and applications of various mirror types.

2.4 Demonstrate a knowledge of filters by discussing the advantages and disadvantages of various filters.

2.5 Use a beam splitter to divide an optical beam into several components.

2.6 Discuss the limitations of a beam splitter.

2.7 Describe configurations and applications of several commonly used prisms.

2.8 Calculate the minimum deviation angle and the index of refraction of a wedge prism.

2.9 Describe configurations and applications of several commonly used lenses.

2.10 Experimentally determine the focal length of a concave and a convex lens.

2.11 Illustrate spherical aberration in lenses and describe a method for reading it.

2.12 Use the grating equation to calculate the wavelength of light incident upon a grating.

2.13 Know when and how to use diffraction gratings in optical experiments.

2.14 Demonstrate a knowledge of polarizers by explaining various types.

2.15 using the principles of absorption, reflection, and refraction explain how the polarizer selects certain transverse vibrations and rejects others.

2.16 Polarize a light beam and plot a curve of intensity versus angle of rotation.

2.17 Discuss nonlinear optical materials and their applications.

Competency 3: Detectors - photo, laser power, and energy.

In order to attain this competency, the student should be able to:

3.1 Demonstrate a knowledge of the theory of operation and application of basic photo-emissive, photo-conductive, and photo-voltaic devices.

3.2 Describe and sketch a laboratory set up for measuring noise equivalent power.

3.3 Calculate the shot noise current from a photodiode detector.

3.4 Calculate the Johnson noise voltage across a resistor.

3.5 Measure the absolute responsivity of a silicon photodiode detector.

3.6 Measure the linearity of a photodiode detector and determine the saturation point.

3.7 Demonstrate a knowledge of optical power meters.

3.8 Discuss the radiometric and photometric measurement systems.

3.9 Discuss each of the components and their function in a typical power/energy meter.

3.10 Using the pulse shape and peak power measurements, calculate the output energy of a pulsed laser.

Competency 4: Photographic and holographic techniques and equipment. In order to attain this competency, the student should be able to:

4.1 Exhibit a knowledge of the accessories and techniques of oscilloscope photography in recording repetitive and nonrepetitive events.

4.2 Discuss the operation and application of an infrared image converter.

4.3 Operate a Q-switched laser.

4.4 Photograph the pump pulse and laser output pulse of a Q-switched laser.

4.5 Calculate the peak power output of a Q-switched laser.

4.6 Use the necessary laboratory equipment to produce good holograms.

4.7 Discuss split beam transmission and reflection holograms, single beam transmission and reflection holograms, and sine grating holograms.

4.8 Sketch the appearance of noise in a finished hologram from a laser with no spatial filter, plane parallel beam splitter, and dust particles.

4.9 Reduce intermodulation noise by selecting the correct angle between the object and reference beams.

Competency 5: Collimators, expanders, and isolators. In order to attain this competency, the student should be able to:

5.1 Explain the basic design and application of the ordinary collimator and the autocollimator.

5.2 Discuss the "focused return" method and the "autocollimated return" method of aligning spherical mirrors using an adjustable autocollimator.

5.3 Align a laser with an autocollimator.

5.4 Demonstrate a knowledge of laser beam expanders and spatial filters.

5.5 Explain the basic design of the Galilean and Keplerian beam expanders.

5.6 Understand the fundamental principles of spatial filtering of a laser beam.

5.7 Calculate the angular divergence of an expanded laser beam.

5.8 Using a HeNe laser beam, align a spatial filter.

5.9 Based upon the Faraday rotation effect, explain the basic design and operation of optical isolators.

5.10 Describe how bleachable dye absorber functions as an optical isolator.

5.11 Build and use a Faraday rotation device to demonstrate the principles of an optical isolator.

Competency 6: Modulation and Q switching. In order to attain this competency, the student should be able to:

6.1 Describe the operation of a bleachable dye Q-switch.

6.2 Describe the phenomenon of mode-locking and calculate pulse spacing and minimum pulse duration.

6.3 Discuss mechanical light beam deflection including galvanometer and rotating mirrors, and piezo-electric deflectors.

6.4 List the advantages and disadvantages of mechanical light beam deflectors.

6.5 Operate a bleachable dye Q-switched laser.

6.6 Discuss the operation, applications, advantages and disadvantages of electro-optic devices.

6.7 Understand the birefringence phenomenon.

6.8 Calculate the transmission of an electro-optics modulator.

6.9 Measure the modulation frequency and transmission of the modulator.

6.10 Discuss the operation, application, advantages and disadvantages of acousto-optic devices.

6.11 For an acousto-optic device measure the angle of deflection, the number of resolvable spots and the modulation.

6.12 State how an acousto-optic device can be used either as a modulator or a deflector.

6.13 Compare the output of a mode locked laser to the output of a nonmode locked laser.

6.14 Draw, label, and explain the pulse train produced by a mode locked pulsed laser.

6.15 Measure the minimum pulse duration, pulse repetition time, and the number of nodes oscillating.

6.16 Operate a mode locked pulsed laser.

Competency 7: Optical instruments. In order to attain this competency, the student should be able to:

7.1 Understand the characteristics of the prism spectrometer and the grating spectrometer.

7.2 Define and calculate the resolving and dispersive powers of both types of spectrometers.

7.3 Set up and align a prism spectrometer for use in measurement of reflective index and wavelength.

7.4 Measure the wavelength of a light source using both types of spectroscopes.

7.5 Use a monochromator to obtain transmission and absorption spectra of optical filters.

7.6 Demonstrate a knowledge of monochromators.

7.7 Explain the methods used to obtain the absorption spectrum of a liquid.

7.8 Define percent transmission, absorbance, and molar absorptivity.

Competency 8: Interferometric measurements. In order to attain this competency, the student should be able to:

8.1 Discuss the components of a Michelson, Fabry-Perot, Twyman-Green, and Mach-Zehnder interferometers.

8.2 Accurately measure the wavelength of a spectral line, the difference in wavelength between adjacent spectral lines, and the coherence length of a HeNe laser.

8.3 Determine the line width of optical sources.

8.4 Adjust a laser to operate in a single transverse mode.

8.5 Use a Twyman-Green interferometer to test lenses, prisms, optical flats, and glass for imperfections.

8.6 Explain how to use the Mach-Zehnder interferometer to measure density, pressure, and temperature changes in gases.

Recommended Course Textbooks

Laser and Electro-Optic Components
Laser/Electro-Optical Technology Series Vol. 6
Center for Occupational Research & Development

Laser/Electro-Optic Devices
Laser/Electro-Optical Technology Series Vol. 7
Center for Occupational Research & Development

Laser/Electro-Optic Measurements
Laser/Electro-Optical Technology Series Vol. 10
Center for Occupational Research & Development

Attendance Requirements

Students are expected to adhere to the attendance requirements that are delineated in the college catalog.

Safety Considerations

Students are urged to dress appropriately, exercise caution in the laboratory, and wear eye protection when recommended.

Summary of Topics/Course Outline:

	Vol.	Chap.	Weeks
Tools of Technology	6	1&2	1
Precision Optical Components	6	4-11	4
Detectors	7	1&2	1
Photographic & Holographic Techniques	7	3&4	1
Collimators, Expanders, and Isolators	7	5-7	1
Modulation and Q-switching	7	8-11	2
Optical Instruments	10	2-3	2
Interferometric Measurements	10	4-8	2
Review	--	---	1

Course Competencies For:

1. <u>Laser Applications and Projects - LEO 202</u> 4 Credits
3 lect., 2 lab.

2. Course Description: Practical application is the primary focus of this course. The student is exposed to fabrication methods, calibration techniques and a wide variety of materials that are in use today.

   Suggested Audience: Laser/Electro-Optics Students

   Prerequisite: Laser Measurements and Equipment - LEO 201

3. Course Competencies/Behavioral Objectives

   Competency 1: Laser materials processing. In order to attain this competency, the student should be able to:

   1.1 Demonstrate a knowledge of welding.

   1.2 Weld wires together using a ruby laser.

   1.3 Join two sheets of plastic using a CO_2 laser.

   1.4 Measure the depth of penetration of the weld versus laser power.

   1.5 List the advantages and limitations of laser welding.

   1.6 Describe how a laser beam vaporizes solid surfaces.

   1.7 Enumerate the advantages and limitations of laser hole drilling.

   1.8 Calculate the maximum hole depth that can be drilled in a specific material.

   1.9 Cut lucite and scribe ceramic materials.

   1.10 Set up a system tc drill holes in metal targets.

Competency 2: Data processing. In order to attain this competency, the student should be able to:

2.1 Describe the advantages of an optical computer.

2.2 Describe a holographic optical computer memory.

2.3 State how optical processing works.

2.4 Calculate the brightness of a display which uses laser light to form the display.

2.5 Describe a light valve array system that employs laser control.

2.6 Understand the operation of the ferroelectric-photoconductor sandwich devices.

2.7 Calculate the transmission of a ferroelectric material between crossed polarizers.

2.8 Assemble and operate a display using a laser.

Competency 3: Testing and monitoring. In order to attain this competency, the student should be able to:

3.1 Demonstrate a knowledge of laser air pollution monitoring methods.

3.2 Draw an absorption spectroscopy arrangement.

3.3 Describe how Raman scattering is used to identify air pollutants and their concentrations.

3.4 List the advantages and disadvantages of optical radar techniques for measuring air pollutant concentrations.

3.5 Describe optical heterodyne techniques for identifying air pollutants.

3.6 Describe how diffraction can be used to measure dimensions of small objects.

3.7 Detect defects on a flat surface using scattering techniques.

3.8 List the advantages and applications of holographic interferometry.

Competency 4: Rangefinding and angle tracking. In order to attain this competency, the student should be able to:

4.1 Sketch the waveforms for a pulsed ranging system.

4.2 Calculate the maximum pulse rate and minimum received power for a pulsed noncooperative ranging system.

4.3 Describe a CW, tone ranging system and calculate the maximum frequency and received power.

4.4 Set up and operate a pulsed ranging system.

4.5 Demonstrate a knowledge of angle tracking techniques and terminology.

4.6 Describe the basic elements of an angle tracking system and list uses.

4.7 Draw and label a typical commercial alignment system.

4.8 Assemble and operate a laser angle tracking receiver.

4.9 Measure the angular displacement of a laser mounted on a linear translater.

Competency 5: Lasers in medicine, communications and construction. In order to attain this competency, the student should be able to:

5.1 Discuss the absorption of laser light by human tissue and calculate the depth of penetration.

5.2 Calculate the temperature rise in human tissue caused by lasers.

5.3 Describe how photocoagulation is used to treat eye defects.

5.4 Discuss the use of fiber optics in medicine.

5.5 Sketch a block diagram of an optical communication system.

5.6 Identify the properties of CW and pulsed optical transmitters and receivers.

5.7 Demonstrate a knowledge of modulators and modulation schemes used in optical communications.

5.8 Define signal to noise ratio and bit error rate.

5.9 Assemble and operate an AM light emitting diode communications system.

5.10 Demonstrate a knowledge of laser uses in construction including rotating beam and straight line projection laser systems.

5.11 Make a topographic profile of a given area.

Competency 6: Laser projects. In order to attain this competency, the student should be able to:

6.1 Either alone or with a group of students, design a working, student-built laser or other electro-optic device from the following list from Module #9:

**Open-cavity Helium Neon Laser

**Communications Link

**CW pumped Nd:YAG Laser

**Carbon Dioxide Laser

**AutoCollimator

**Optical Power Meter for CW Lasers

**Other Projects as assigned by the instructor.

6.2 Maintain an accurate laboratory notebook containing drawings, schematics, manufacturers' literature, data, and photographs.

Recommended Course Textbooks:

Laser Applications
Laser/Electro-Optical Technology Series Vol. 8
Center for Occupational Reserach & Development

Laser Projects
Laser/Electro-Optical Technology Series Vol. 9
Center for Occupational Research & Development

Attendance Requirements

Students are expected to adhere to the attendance requirements that are delineated in the college catalog.

Safety Considerations

Students are urged to dress appropriately, exercise caution in the laboratory, and wear eye protection when recommended.

Summary of Topics/Course Outline

	Vol.	Chap.	Weeks
Laser Materials Processing	8	1&2	2.5
Data Processing	8	3&4	2.5
Testing and Monitoring	8	5&6	3
Rangefinding and Angle Tracking	8	7&8	2
Medicine, Communications, and Construction	8	9-11	4
Projects	9	1-7	--
Review			1

Special Lab Equipment List:

1. Helium-neon Laser unpolarized - either:
   - Metrologic #ML869 (1.5 mw) $459
   - Metrologic #ML855 (5.0 mw) $695

2. Photoelectric power meter with ambient light shade $135

3. Laser power meter $350

4. Grating spectroscope $250

5. Optical Bench system consisting of: (Metrologic $400)
   - One meter bench
   - Leveling base
   - Pin carriers
   - Mounting pins
   - Laser holder
   - Mirror holder
   - Ring mount

6. Lenses (various combinations)
   - Diverging
   - Converging (5cm focal length)
   - Thin lens positive
   - Thin lens negative

7. Mirrors including:
   - High reflectance (99% reflective @ 632.8 nm)
   - Output mirror (1-2% transmissivity @ 632.8 nm)
   - Plane
   - Concave
   - Convex

8. Prisms 60°, 45° - 45° - 90°

9. Filters
   - 632.8 nm
   - neutral density (1% transmission)
   - Set of 7 broadband interference filters
     - Optical Industries #03F1B015

10. Set of precision apertures on 35 mm glass slides
    - Single, double, and multiple slits
    - Circular apertures
    - Square aperture
    - Grating (Pasco Scientific)

11. Collimator Tropel #280

12. Polarizer Coherent #32

13. Beam splitter Oriel #261 $50

14. Beam expander (10X) $190

15. Micrometer

16. Meter stick

ARTICULATION

(Secondary and Post-Secondary Education)

Vocational/occupational education supports the needs of local business and industry and prepares workers with entry-level skills. The need for articulation of programs is becoming more apparent due to growing local and national concerns for efficiency in education, rising costs of education, and elimination of duplication of effort and demands from the public for accountability. Employment needs and trends have changed drastically in the last decade as high technology transformed many jobs.

Coordination of secondary and post-secondary programs was a major theme of the 1976 educational legislation. The 1983 efforts of the Pennsylvania Advisory Council on Vocational Education fostered, among other things, stronger business and industry linkages with vocational programs and articulation efforts between secondary and post-secondary and adult vocational education programs.

In 1983, the Pennsylvania Advisory Council on Vocational Education made a recommendation on articulation agreements. The recommendation, as it addressed articulation, stated:

> 4. Articulation agreements between comprehensive schools, community colleges, colleges, universities and AVTS should be established. These agreements should stimulate joint efforts in facilities' utilization, curriculum planning, providing customized job training, utilizing business/industry contracts, etc. These agreements would be considered in the approval process for receiving state and federal vocational education funds.

Further, articulating programs between secondary area vocational-technical schools and the local community college would maximize the efforts and efficiency of our state educational system. This integration would be efficient and economical in terms of better use of facilities, staff and equipment, reduced length of study time, and the ability to address employer needs in a systematic plan.

In the development of this curriculum, the Laser/Electro-Optics Technology Program, it was designed to build upon maximum integration of at least two major state education delivery systems, the community college and the secondary vocational-technical system. With this articulation plan and cooperation in mind, a decision must be made as to which students could profit the most from this learning experience.

Generally speaking, secondary students with a mathematics, physics and/or electronics background seemed to have many of the basic skills necessary for a smooth articulation. These general categories suggest students from course selections such as:

* Electronics
* Electrical
* Electromechanical
* Mathematics, Science, Physics

* and other courses as deemed appropriate by a joint committee of the community college and the area vocational-technical school.

Specific courses which seem to be appropriate or reasonable starting points of exploration of articulation include:

* D.C. Electricity,
* Technical Mathematics,
* Technical Physics,
* A.C. Electricity, and
* Electronic Devices

While no one student would be expected to possess the background and/or competencies in all of the above courses, different students from various courses (programs) would have completed parts of or complete courses. Again, the determination of breadth, depth and evaluation of the articulation agreement should be determined by the joint committee.

Other courses not mentioned above should also be waived by students possessing competency in that area. Usually most institutions have a mechanism of evaluation to assess that background.

SECTION IV:

ATTACHMENTS

ATTACHMENTS

1. Curriculum Development Task Force
2. Task Force Data/Recommendations
3. Advanced Technology Center Brochure
4. Program Brochure
5. Equipment Specifications
6. Special Considerations for Laser Lab
7. Use of Laser Lab for Technical Physics

Attachment #1

CURRICULUM DEVELOPMENT TASK FORCE

1987 - 88

1. George Butwin
   Meyers High School

2. Joseph DeSanto
   Luzerne County
   Community College

3. Stanley Fraind
   Crestwood High School

4. Albin Grabowski
   Wilkes Barre AVTS

5. James Haggerty
   Wilkes Barre AVTS

6. Kathleen Heltzel
   West Side AVTS

7. James Kane
   West Side AVTS

8. Joseph Kasztejna
   Monroe Country AVTS

9. Edward Kuehner
   Luzerne County
   Community College

10. Kenneth Lewis
    Luzerne County
    Community College

11. Ormond Long
    Wilkes Barre AVTS

12. David Lyons
    West Side AVTS

13. Robert Mattern
    GAR High School

14. James Newell
    Wilkes Barre AVTS

15. Arthur Parsons
    Wyoming Valley West
    Sr. High School

16. Ben Rondomanski
    Lackawanna County AVTS

17. Walter Rounds
    Lackawanna County AVTS

18. Leonard Tarapchak
    Hazleton AVTS

19. Nathan Williams
    Wilkes Barre AVTS

ATTACHMENT #2

Task Force Data/Recommendations

ATTACHMENT #2

Book Review

1. Basic Manufacturing Processes
   Kazanas, Baker, Gregor
   Dave Lyons - Text adequate in coverage of manufacturing areas
   Robotics not mentioned
   Format and photographs reveal that the book is dated
   Recommend use of a more modern text
   Lenny Tarapchak - Not very up to date
   Material covered is somewhat insignificant
   I do not recommend this book
   Joe Kasztejna - Recommend this text for GET 121
   Contains all needed information to meet competency requirements
   Information in the text is up to date and well written
   Illustrations are also very good
   Jim Newell/Nate Williams - Out of date
   Recommend look for a different text

2. Principles of Machining
   American Society for Metals
   Joe Kasztejna - Text collection of technical writings in module form
   Each module can be used as a separate lesson with many of the competency requirements matching the lessons
   Recommend that the text be be used as separate lessons with the order revised to meet course competency requirements
   Lenny Tarapchak - Well defined processes as well as good back-up materials
   Recommend this book

Advanced Placement

Lenny Tarapchak recommends a written and a practical test. The time limit for both sections of the test is approximately 6 hours. Sample test attached.

Joe Kasztejna recommends a written and a practical test for Manufacturing Processes II. The practical test should emphasize competencies 3, 4, and 5. Manufacturing Processes I has a heavy emphasis on theory and therefore only requires a written test. Comments attached.

Additional Comments

SKETCHING AND PRINT INTERPRETATION (GET 108)

Book Review

1. Blueprint Reading for Industry

   Walter Brown

   Ben Rondomanski - Recommends use of this text with additional handouts to cover competency requirements not included
   May require use of second text

   John Witko - Material in the text is well written and easy to understand
   Instructor should present the material in a different order than the book
   Meets the competency requirements of the course
   The text can be used by a beginner or by someone with some experience
   The advanced section uses a variety of blueprints with different styles

Advanced Placement

Ben Rondomanski provided the attached test for advanced placement. John Witko feels the test is a good starting point for advanced placement criteria. Portfolios, interviews, etc. still must be examined.

Additional Comments

John Witko feels that actual industry blueprints should be used whenever appropriate. He is currently working on prints and parts for various sections of the course.

INTRODUCTION TO COMPUTER PROGRAMMING (GET 234)

Book Review

not applicable - current course

Advanced Placement

Kathy Heltzel recommends a one (1) hour written test and a one (1) hour practical test. The written test should include the following:

Know the difference between micros and mainframe computers

Know the function of and understand the differences between hardware, software, electronic spreadsheets, peripheral devices, etc.

Know and explain the following terms and acronyms: Input, output, peripheral, CPU, graphics, bit, PC, LAN, mouse, hard copy, boot, execute, storage device, RAM, ROM, disk storage, CRT, byte, modem, ASCII, light pen, hard disk, files, debug, database, floppy disk, format, initialize, DOS, BASIC, microprocessor, host computer, remote terminal, monitor, menu, mode, backup, program

Know and understand the following commands - the exact command may differ depending on the computer used. But whatever computer is used, one must learn the commands. directory, erase, kill, BASICA - command to get in BASIC mode, system - to get back to system mode, rename

Know and understand the following BASIC commands - the above statement is still true regarding the computer used. SAVE, LIST, LOAD, PRINT, AUTO, LET, SUBR, FOR/NEXT, RUN, SYSTEM, EDIT, ERASE, DELETE, GOTO, IF THEN, READ DATA, INSERT

Know how to boot up the system - both ways

Know how to format a floppy disk to prepare it for use. Understand why we must prepare a disk.

Understand all the words listed previously and know what the acronyms mean in terms of the function they perform.

Know how to key in a program, execute it, debug it, and test it after corrections have been made.

Know how to call up files, check what is on your disk.

Know and understand all components of a PC, how they interface.

Know and understand where the PC field is going technologically.

Know and understand databases - internal and external.

Know and understand the additional equipment needed to access an external database.

Know and understand the difference between packaged software and user written programs.

Have an introductory knowledge of spreadsheets.

Additional Comments

D.C. AND A.C. ELECTRICITY (IEL 131 & 132)

Book Review

not applicable - current course

Advanced Placement

D.C. Electricity - May 10, 1988 discussion (attached)

Additional Comments

FLUID POWER (ASR 207)

Book Review

1. Industrial Hydraulics

Pippenger and Hicks

Jim Newell/Nate Williams - Book is outdated

The text looks at fluids from a plumber's point of view

Need robotic point of view for this program

Walter Rounds - Book covers competencies as specified

It is not easy to read

I do not recommend this text

Advanced Placement

Not appropriate at this time.

Additional Comments

Walter Rounds suggests we review the following books for this course:

1. Mobile Hydraulics Manual
   Technical Training Center
   VICKERS, Inc.
   1401 Crooks Road
   Troy, Michigan 48084
2. Industrial Hydraulic Technology
   Bulletin 0221-B1
   Power and Controls Group
   Parker-Hannifin Corp.
   17325 Euclid Avenue
   Cleveland, Ohio 44112

CIM 101/103/104

Book Review

1. Basic CNC Programming
   Laviana and Cormier
   Lenny Tarapchak - More an example of a ready reference book than an actual theoretical book

2. Principles of Numerical Control
   Childs
   Al Grabowski - Book is obsolete - used a book like this in 1961

DIGITAL ELECTRONICS (IEL 205)

Book Review

not applicable - current course

Advanced Placement

Art Parsons recommends a written and practical test. The test(s) should be designed so that the same test can be given in various forms. This would prevent students from passing the test information on to other students. A sample test is attached.

Additional Comments

MANUFACTURING PROCESSES

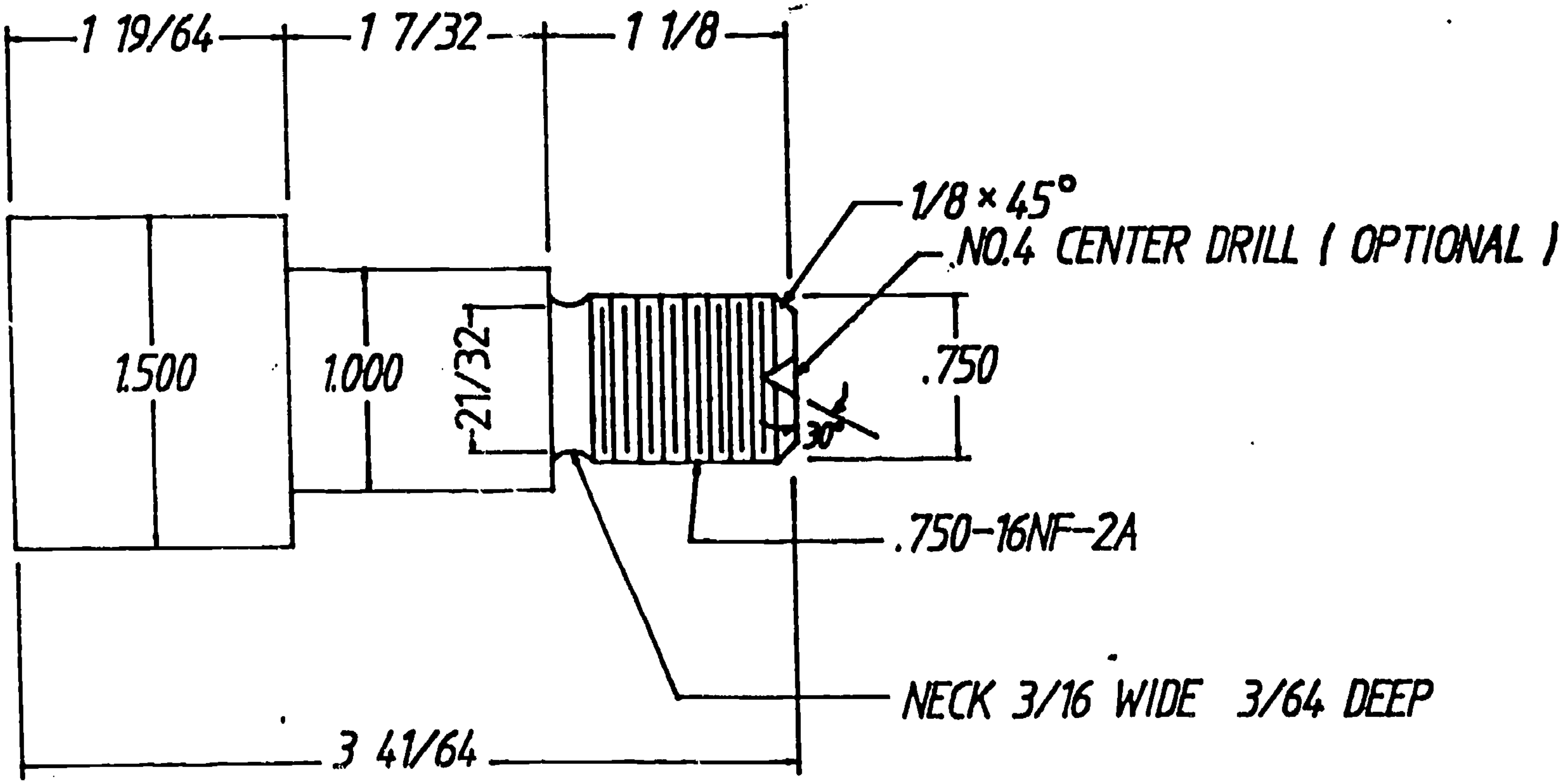
LAB ADVANCED

PLACEMENT

Job/Task: ENGINE LATHE

PERFORMANCE OBJECTIVE:

The student given the necessary print and materials, will have two (2) hours to turn, neck, angle, and thread the lathe project. The student will be evaluated according to the operations of an engine lathe, General safety specifications, and tolerances on the Blueprint.



UNLESS OTHERWISE SPECIFIED:

LIMITS ON DECIMAL DIMENTIONS WITHIN ±.001"

LIMITS ON FRACTIONAL DIMENSIONS WITHIN ±1/64"

INSPECTION SHEET

Student_____________________ Instructor_______________

PROJECT: TURNING EXERCISE.

Length, overall 3 41/64 _______

Diameters, O.D.

1.500 x 1 19/64 _______ x ______

1.000 x 1 7/32 _______ x ______

.750 x 1 1/8 _______ x ______

1/8 x 45 Chamfer _______ x ______

3/16 x 21/32 Neck _______ x ______

.750-16 T.P.I. _______ x ______

Class 2A

WORKMANSHIP ________________

GRADE ________________

MANUFACTURING PROCESSES

LAB ADVANCED

PLACEMENT

Job/Task: MILLING MACHINE

PERFORMANCE OBJECTIVE:

The student given the necessary print and materials, will have 1 hour to mill, drill, ream the project. The student will be evaluated according to milling, drilling and reaming safely, general safety specifications and tolerances on print.

MANUFACTURING PROCESSES

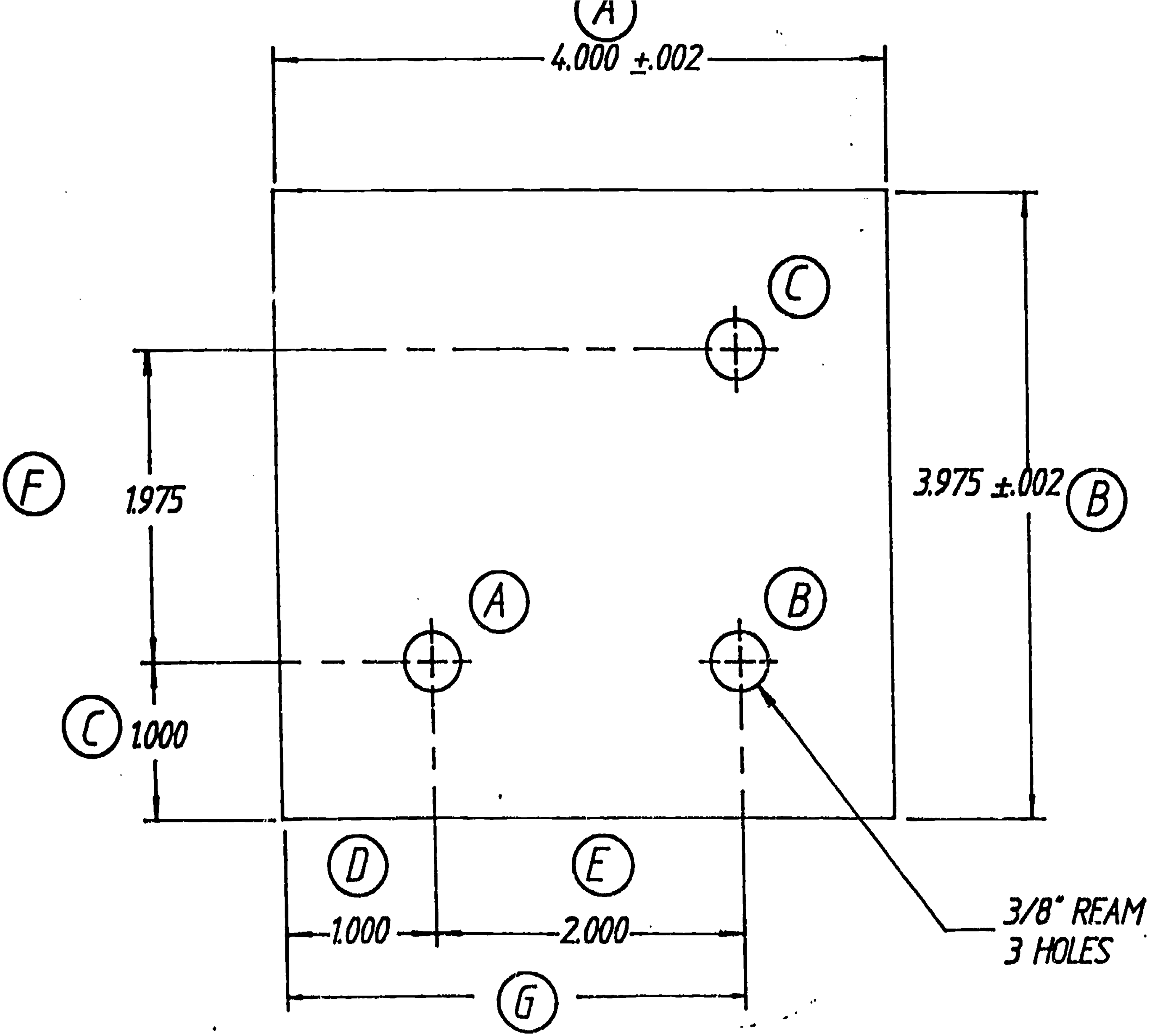
LAB ADVANCED

PLACEMENT

Job/Task: LAYOUT WORK

PERFORMANCE OBJECTIVE:

The student given the necessary print and materials will layout work piece that will be milled, drilled and reamed. The student will be evaluated according to the specifications of print and tolerances and general safety.



UNLESS OTHERWISE SPECIFIED:

LIMITS ON DECIMAL DIMENSIONS WITHIN ±.001"

INSPECTION SHEET

STUDENT________________________ Instructor__________________

PROJECT --- VERTICAL MILLING, DRILLING, REAMING EXERCISE.

Length A 4.000 $\pm$ .002 ____________________________

Length B 3.975 $\pm$ .002 ____________________________

Location of Hole A - 1.000 x 1.000 $\pm$ .001 _______________

Location of Hole B - 1.000 x 2.000 $\pm$ .001 _______________

Location of Hole C - 3.000 x 2.975 $\pm$ .002 _______________

Location of C - 1.00 $\pm$ .001 ____________________________

Location of D - 1.00 $\pm$ .001 ____________________________

Location of E - 2.00 $\pm$ .001 ____________________________

Location of F - 1.975 $\pm$ .001 ____________________________

Location of G - 3.000 $\pm$ .002 ____________________________

3 Holes Ream to 3/8" Dia. $\pm$ .001 ______________________

WORKMANSHIP ______________________________

GRADE ______________________________

MANUFACTURING PROCESSES

LAB ADVANCED

PLACEMENT

Job/Task: SURFACE GRINDING

PERFORMANCE OBJECTIVE:

The student given the necessary print and materials will have 45 minutes to dress grinding wheel, to achieve size and finish the project.

The student will be evaluated according to the operations of a surface grinder, safety, general safety, specifications and tolerances on print.

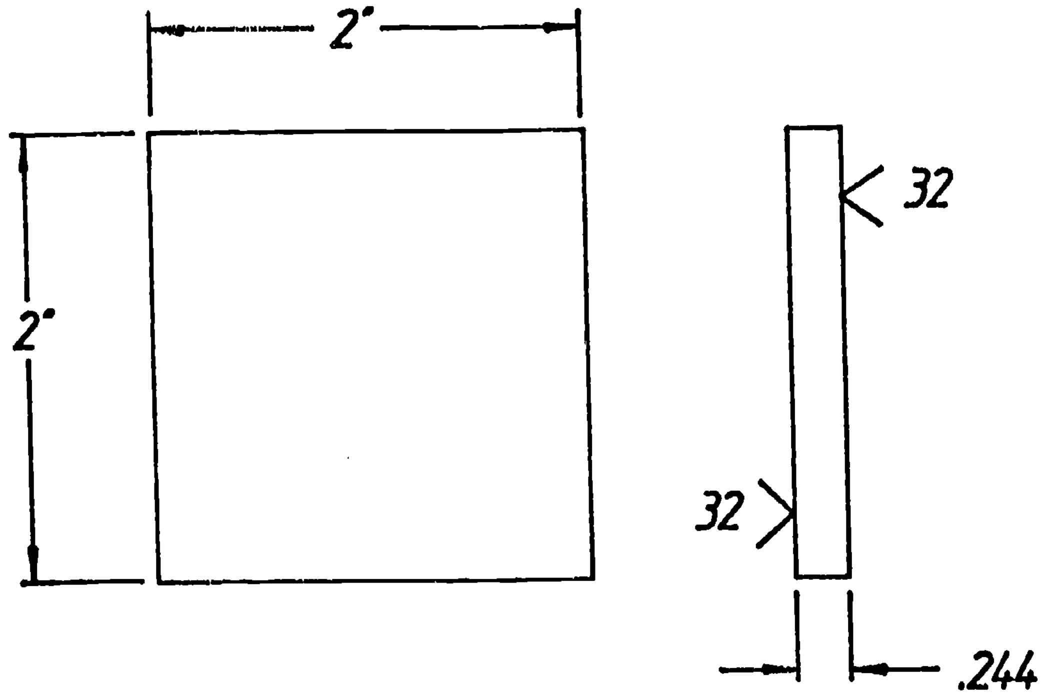


PLATE:
C.R.S.
BREAK ALL SHARP EDGES
LIMITS ON DECIMALS +.0005 −.0000
LIMITS ON FRACTIONS ±1/64"

INSPECTION SHEET

Student ________________ Instructor________________________

	32	
Grind Finish	.244	
	+.0005	
2 surfaces	- 0000	________________________________

MANUFACTURING PROCESSES

LAB ADVANCED

PLACEMENT

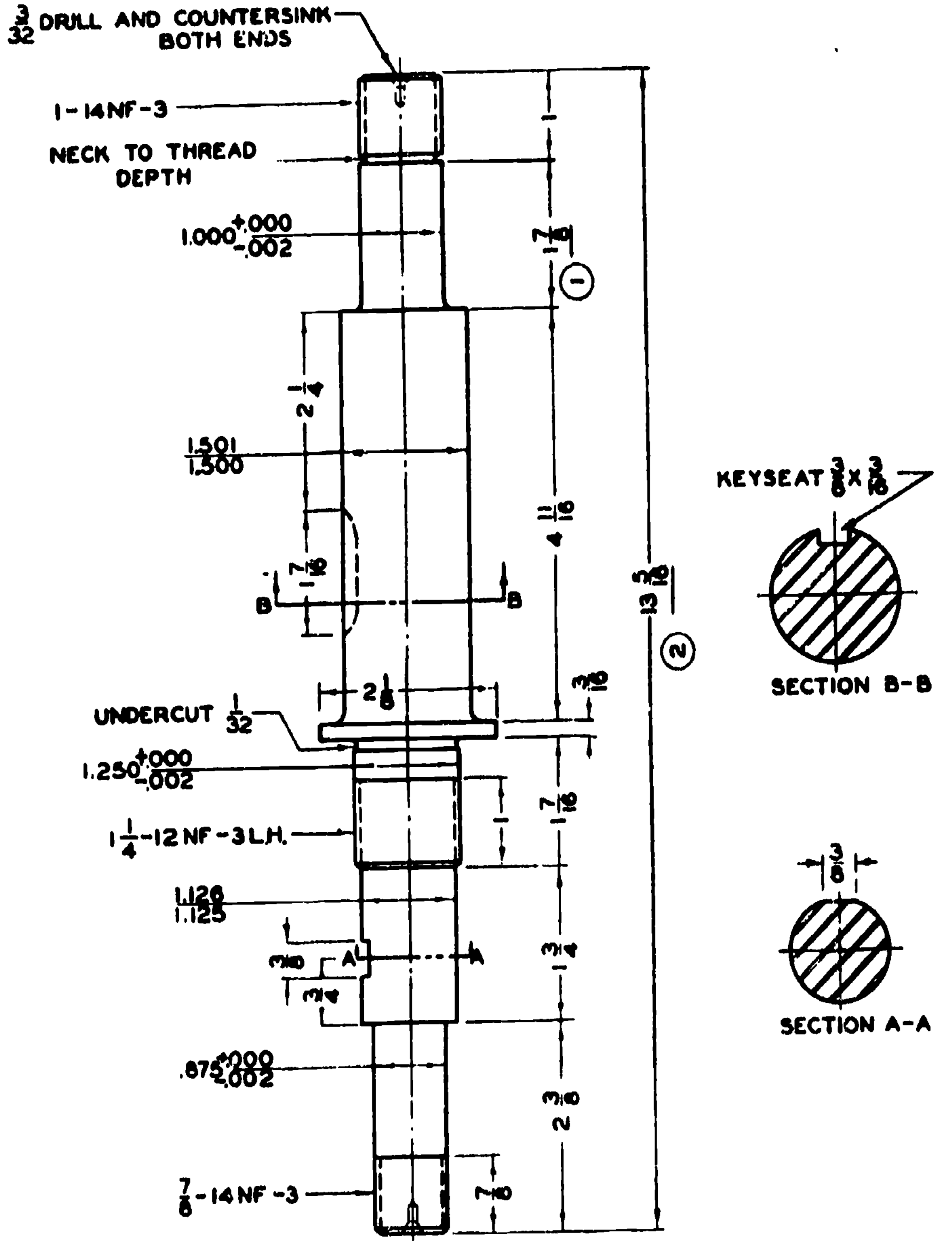
Job/Task: BLUEPRINT READING

PERFORMANCE OBJECTIVE:

The student given the necessary Blueprint will have 45 minutes to interpret this drawing.

The student will be evaluated according to the number of questions answered correctly of given Blueprint.

A minimum of 85 percent accuracy is required.



NOTE: ALL FILLETS 1/8 R

CHAMFER STARTING END OF ALL THREADS 30° TO THREAD DEPTH

NO.	CHANGE	DATE	BY
(2)	WAS 13 1/16	9/22/40	R.C.L.
(1)	WAS 1 5/8	9/22/40	R.C.L.

QTY.	ORDER NO.	DATE	DWG. BY	CK. BY	APP. BY
42	16-172	[redacted]	SCALE 6=12	MAT. S.A.E. 3135	H.T.

UNLESS OTHERWISE SPECIFIED:
LIMITS ON DECIMAL DIMENSIONS WITHIN ± .005"
LIMITS ON FRACTIONAL DIMENSIONS WITHIN ± 1/64"
LIMITS ON ANGULAR DIMENSIONS WITHIN ± 1/2°

SPINDLE SHAFT

FINISH:
BREAK ALL SHARP EDGES

D-20

BEST COPY AVAILABLE

SPINDLE SHAFT

1. What is the name of the part? ____________

2. What is the blue print number? ____________

3. What is the material used? ____________

4. What is the largest diameter on the shaft? ____________

5. What is the overall length on the shaft? ____________

6. Starting at the bottom end of the shaft, what are the successive diameters up to the 2-1/8" diameter? ____________

7. Starting at the top end of the shaft, what are the successive diameters down to the 2-1/8" diameter? ____________

8. At how many places are threads being cut? ____________

9. Starting at the bottom, what are the thread diameters along the shaft? ____________

10. Specify, for any left-hand thread on the job, the thread diameter and number of threads per inch. ____________

11. How many threads per inch are being cut on the 7/8", $1\frac{1}{4}$", and 1" diameters? ____________

12. What class of fit is required on the threads? ____________

13. Is this a close fit or a loose fit? ____________

SPINDLE SHAFT

14. What is the length of that portion of the shaft which has the 7/8"-14 thread? __________

15. What is the length of the thread cut along this diameter? __________

16. How much clearance is allowed between the last thread and the shoulder on the 7/8" diameter? __________

17. What is the length of the 1.125" diameter? __________

18. What is the upper limit of size of the 1-1/8" diameter? __________

19. What is the lower limit of size of the 1-1/8" diameter? __________

20. How long is that portion of the shaft which has the 1$\frac{1}{4}$"-12 thread? __________

21. What is the length of the 1$\frac{1}{4}$"-12 thread? __________

22. What is the distance from the thread (1$\frac{1}{4}$"-12) to the 2-1/8" diameter shoulder? __________

23. What is the largest size to which the 1.250" portion of the shaft can be turned? __________

24. What is the smallest size to which this can be turned? __________

25. How far is it from the bottom end of the shaft to the shoulder of the 2-1/8" diameter? __________

26. How far is it from the shoulder made by the 7/8" and 1.125" diameters to the center of the flat? __________

SPINDLE SHAFT

27. In section A-A is shown the cut across the shaft at the point the flat is milled. How wide is the flat cut? ________

28. What width of cutter is used in milling the flat? ________

29. How far is it from the bottom end of the shaft to the shoulder formed by the 1.125" and 1.250" diameters? ________

30. What is the thickness of the 2-1/8" collar? ________

31. How far from the top end of the shaft is the 2-1/8" shoulder? ________

32. How long is the 1.500" diameter? ________

33. How long is the 1" diameter? ________

34. What is the length of thread cut on the 1" diameter? ________

35. For what purpose is the 3/16" x 3/8" cut in section B-B used? ________

36. What is the length of this cut? ________

37. How far is this cut from the shoulder of the 1" diameter? ________

38. What is the largest diameter to which the 1.500" shaft can be turned? ________

39. What is the amount of chamfer on each end of the piece? ________

40. What operation cuts below the 1¼" diameter near the collar? ________

TO: Wesley E. Franklin
FROM: Joseph P. Kasztejna
SUBJECT: Criteria for Advanced Placement
RE: April 22, 1988

****

AREA: **MANUFACTURING PROCESSES LAB I**

All course competencies and objectives for Manufacturing Processes Lab I are designed to require the student to absorb theoretical information. Because of the emphasis on theory, I would recommend a comprehensive written test to obtain advanced placement status for this course or study. The questions on this test must be based on the seven course competencies and their objective.

AREA: **MANUFACTURING PROCESS LAB II**

Competencies and objectives for Manufacturing Processes Lab II are both theoretical and practical. I recommend both a comprehensive written test and a practical shop test. The written test should measure the student's ability to identify various machines, machining operations, cutters, holding devices, and measuring instruments use in the machine field. The test should also include blueprint reading, mathematics and safety practices used in the setup and operation of basic machine tools.

The practical test for LAB II should require the student to demonstrate his/her ability to use precision measuring instruments and perform both precision and semi precision layout. The actual machine tool operation part of the practical test should require the student to complete one or two projects that would test his/her ability to setup and operate the following machine tools.

COMPETENCY	MACHINE TOOL	OPERATION TESTED
No. - 3	Lathe	Straight turning, shoulder turning, drilling, angle turning, threading, select tooling, measuring, tool sharpening
No. - 4	Verticl Milling	Align fixtures, attachments and cutting tools; slot cutting; mill to length; mill sides square; drilling with a milling machine.
No. - 5	Grinding Surface	Dress grinding wheel, secure workpiece, perform parallel grinding, setup and grind 90 to parallel surface

As part of the practical test the student should be observed selecting the proper tools and cutters, using proper procedures when setting up machine tools, setting proper cutting speeds and feed rate, and working in a safe and careful manner. The practical test should have an area in its criteria for safety and work habits observed as the student performs the test.

G.E.T. 108 SKETCHING & PRINT INTERPRETATION

PART I - GENERAL INFORMATION

Below are two columns of information, Column A gives terms associated with print reading and Column B provides definitions. On the answer sheet give the letter of the definition that matches the term in Column A.

PART II - MACHINE DRAWINGS

On your answer sheet answer all questions noted.

PART III - WELDING DRAWINGS

On your answer sheet answer all questions noted.

NAME: ______________________ S.S.# ______________

ANSWER SHEET

PART I

1. ______
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______
8. ______
9. ______
10. ______
11. ______
12. ______
13. ______
14. ______
15. ______
16. ______
17. ______
18. ______
19. ______
20. ______

PART II

Section View I ______

Section View II ______

Section View III ______

1. ______
2. ______
3. ______
4. ______
   ______
   ______
   ______
5. ______
6. ______
7. ______
8. ______
9. ______
10. ______

PART III

1. ______
2. ______
3. ______
4. a ______
   b ______
5. ______
6. ______
7. Dia ______
   Lgth ______
8. Size ______
   Qty ______
9. f ______
   h ______
10. Inches ______
    Type ______
11. ______
12. ______
13. ______
14. ______
15. ______
16. ______
17. a ______
    e ______
18. ______
19. ______
20. ______

COLUMN A

PART 1

1. Orthographic Views
2. Dimensions
3. Notes
4. Object Line
5. Hidden Line
6. Threads
7. Extension Line
8. Dimension Line
9. Leader Line
10. Cutting Plane Line
11. Cross Sectioning
12. Assembly Drawings
13. Detail Drawings
14. Auxiliary View
15. Sectional View
16. Tolerance
17. Isometric View
18. Developed Drawing
19. Graphs
20. Single Line Schematic

COLUMN B

PART 1

A. A geometric shape associated with various types of fasteners

B. Values indicating size

C. Contains value and dimensioning distance

D. Bringing a line beyond the object to provide for clear dimensioning and show dimensioning points

E. Positions of an object that are perpendicular to the plane of projection

F. Shows a single unit with contour and size

G. A piping drawing that have all lines in a single plane

H. A technique used to show internal structure of a part

I. Shows the visible shape of an object

J. Represents material being cut by a cutting plane line

K. A drawing providing information of an electrical circuit

L. Points directly to a point of surface to apply a dimension or note

M. The upper and lower limits of a dimension

N. Written information on a drawing applying to an entire drawing or a specific location

O. A drawing that shows relationship between parts

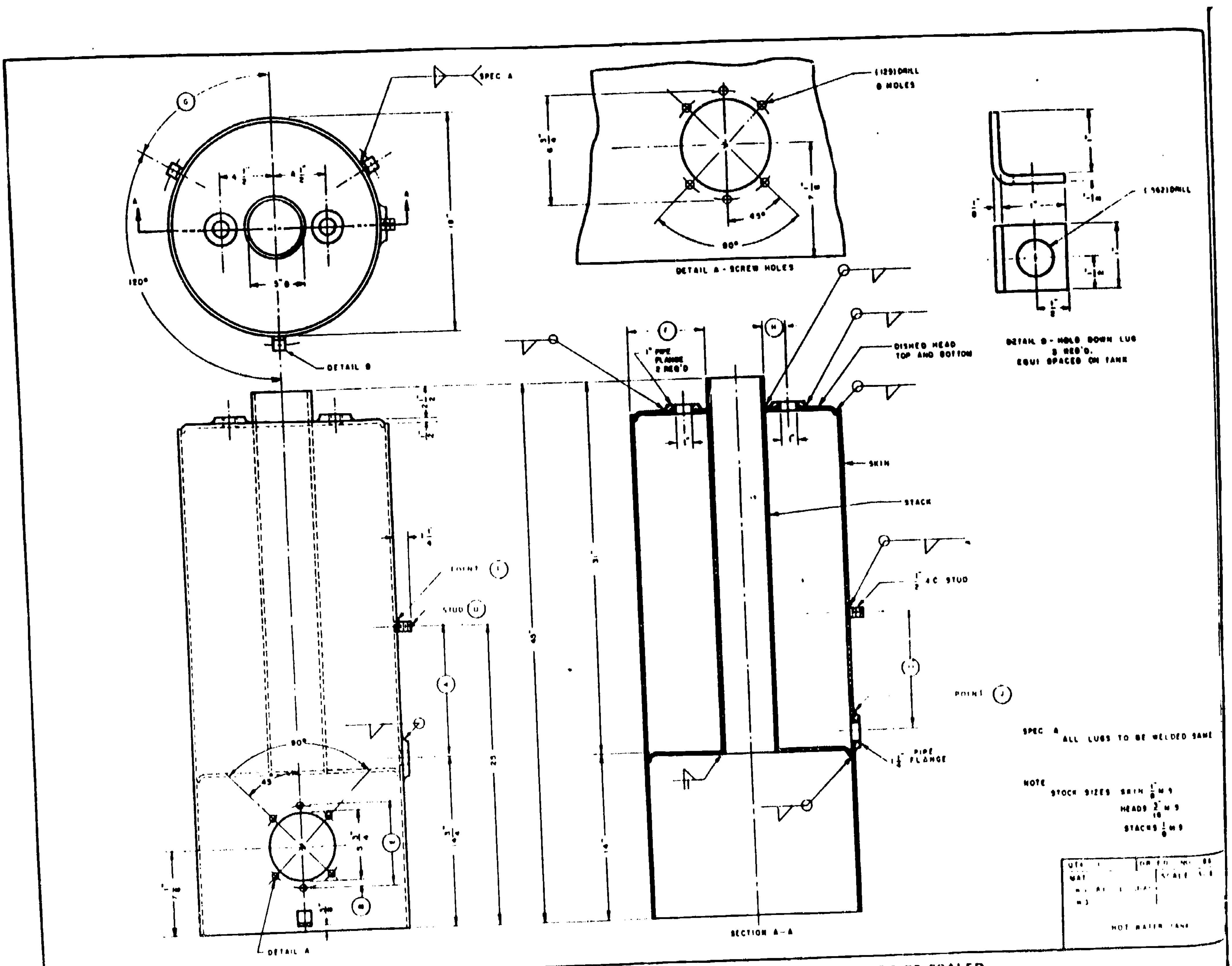
P. A technique used to show description of an inclined or oblique plane

Q. Shows edges and outlines not visible

R. A pictorial type drawing that uses an ordinary scale value

S. Indicates position of view in sectioning

T. A drawing used to represent engineering facts, statistics and/or laws of phenomea



EDITOR'S NOTE: REDUCED PRINT. FOLLOW STATED DIMENSIONS ONLY. NOT TO BE SCALED.

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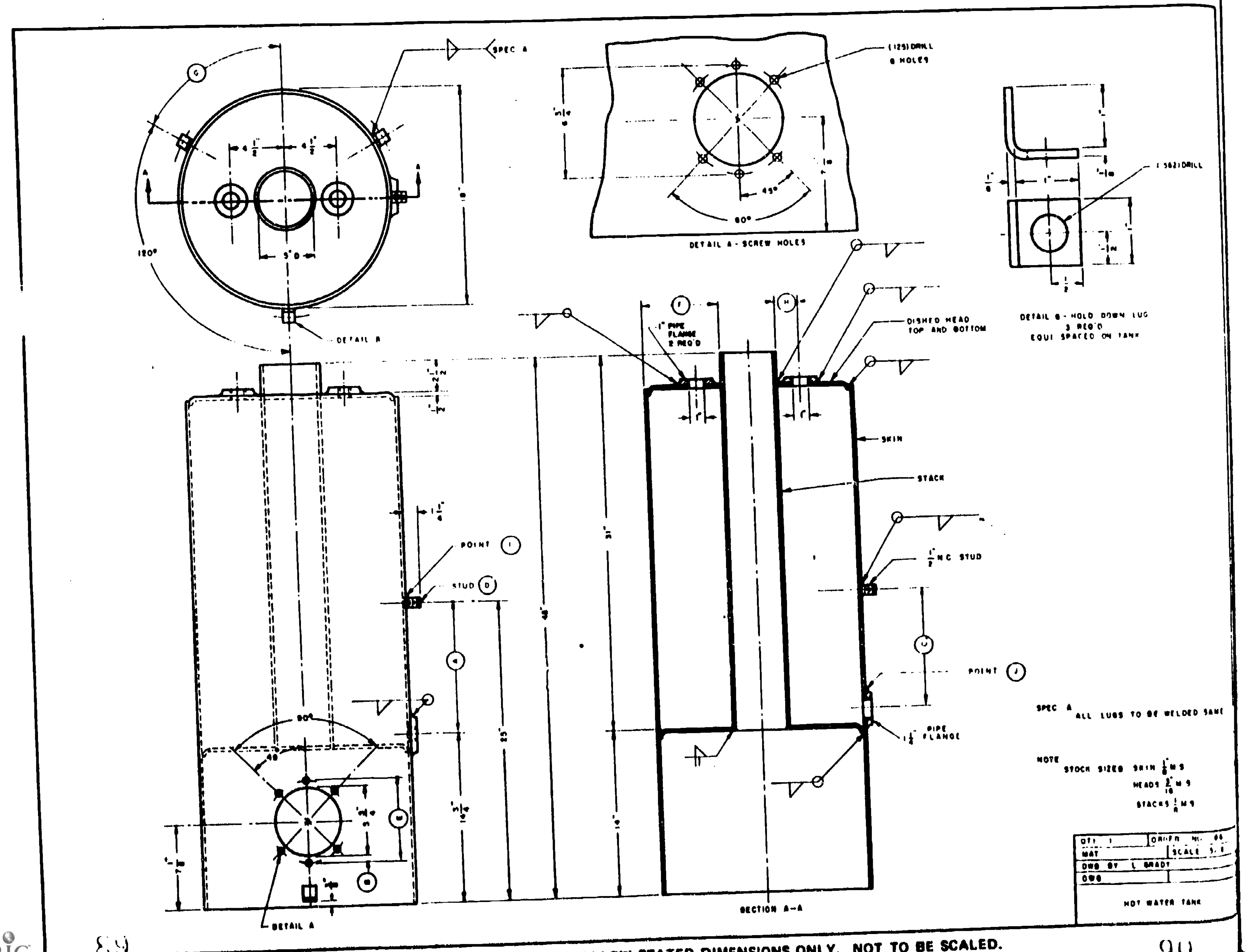
SUMMARY REVIEW NO. 2

A. Refer to the drawing, Hot Water Tank, page 94.

1. How thick is the bottom head? ________
2. How thick is the material used in the stack? ________
3. How thick is the skin of the tank? ________
4. Give the dimensions of the sheet required for the
   a. skin of the tank ______ b. the stack ______
5. What type of threaded fittings are used? ________
6. Give the sizes and number of fittings used. ________
7. What is the diameter and length of stud D ?
   ____
8. What size and how many screw holes are used around the large hole? ________
9. What is the size of distance F ? ____ of H ? ____
10. How many inches and what type of weld is required to join the stack to the head at the top of the tank?
    ____
11. What type of weld is required at point J ? ________
12. What type of weld is used to join the hold-down lug to the tank? ________ ________
13. How many hold-down lugs are there? ________
14. a. Do all these lugs require the same type of weld?
    ____
15. What is the angle of G ? ________
16. What is the distance from the top of the top head to the bottom of the bottom head? ________
17. What is the dimension of A ? ____ of E ? ____
18. What is the distance from the water-holding bottom of the tank to the bottom of the hold-down lugs?
    ____
19. How many degrees apart are the hold-down lugs?
    ____
20. What types of welds are required to join the stack to the bottom of the tank? ________



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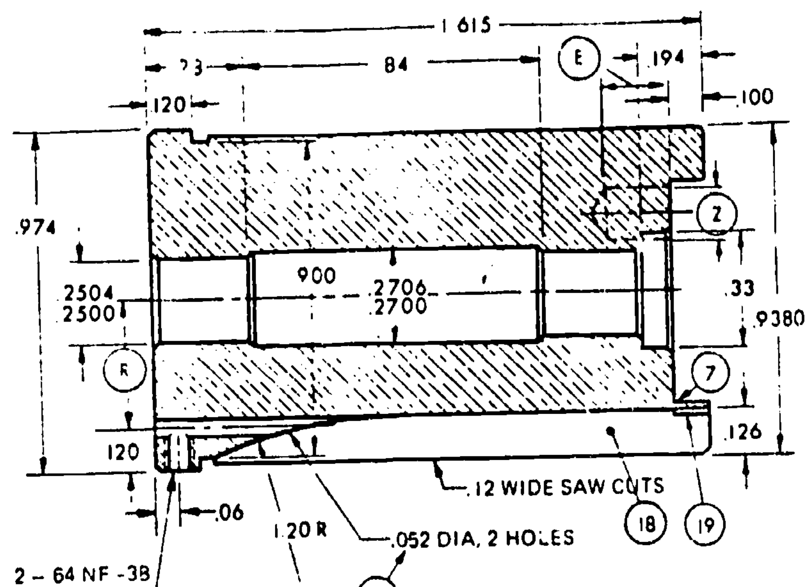
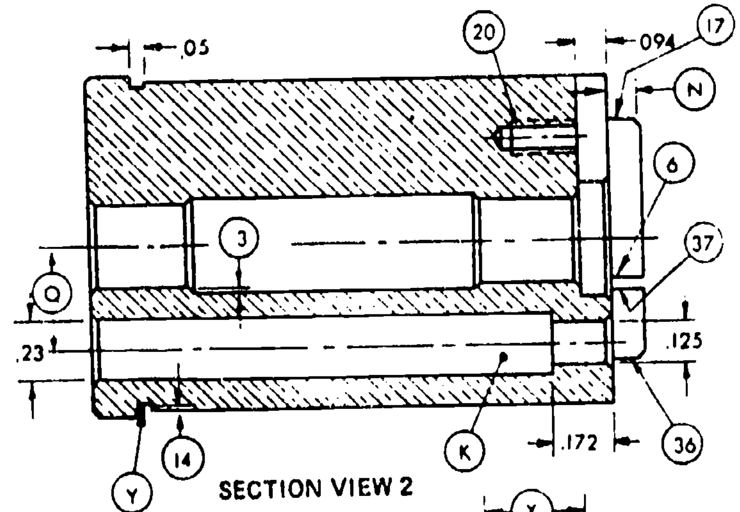
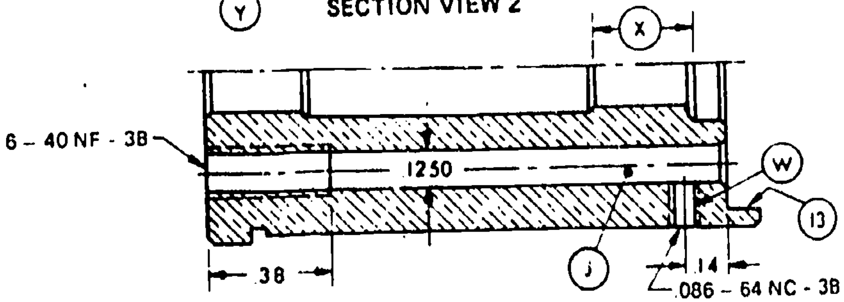


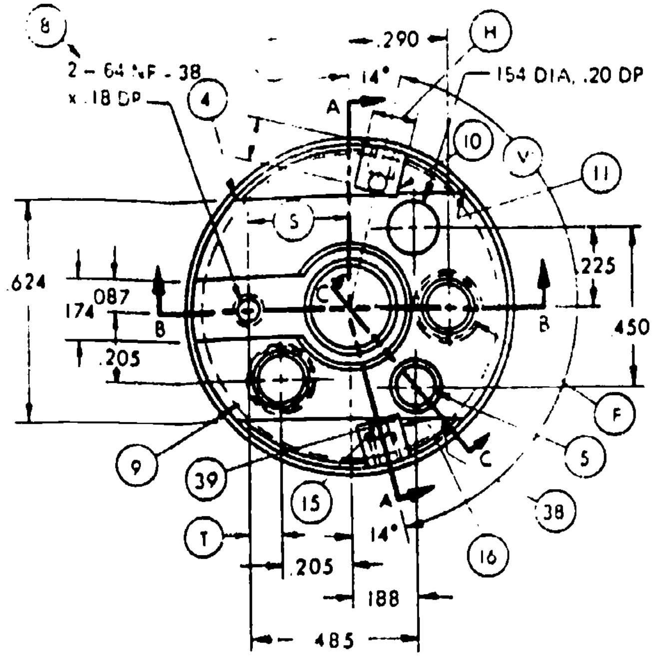
SECTION VIEW 1



SECTION VIEW 2



SECTION VIEW 3



ANSWERS

1 __________

2 __________

3 __________

4 (11) __________
(19) __________
(37) __________
(38) __________

5 __________

6 __________

7 __________

8 __________

9 __________

10 (E) __________

ASSIGNMENT

Label each of the section views with the appropriate titles with reference to the cutting plane lines on the end view.

QUESTIONS

1. What is the diameter of hole (F) ?
2. What is the diameter of hole (Z) ?
3. Identify hole (B) in another view.
4. Locate lines (11) (19) (37) (38) in another view.
5. Determine angle (V) .
6. Locate line (Y) in another view.
7. Determine depth of slot at (14)
8. Determine maximum depth of recess at (3)
9. Locate hole (M) in another view
10. Determine distances (E)

QTY	6
MATERIAL	BRASS
SCALE	2.5/1
DRAWN	DATE
SPINDLE BEARING	A-51

CURRICULUM PLANNING TASK FORCE MEETING
MAY 10, 1988

Discussion of advanced placement criteria resulted in formulation of the following tentative plans and opinions.

D.C. ELECTRICITY

This course had been selected originally as one in which advanced placement might be possible. There seemed to be general agreement that the mathematics background of students from vocational schools and from comprehensive high schools where electronics courses are offered is inadequate to warrant advanced placement in this course. High school instructors stated that their electronics students have a good laboratory background, but the theory and math involved in the D.C. electricity course is such that a student would rarely benefit by exclusion from the course.

There are students, however, who have the lab experience that might be sufficient to exempt them from either <u>all</u> or <u>part</u> of the D.C. experiments.

DIGITAL ELECTRONICS

All participants agreed that this course might be one in which both vocational high school and comprehensive high school students with electronics backgrounds might earn advanced placement.

TECHNICAL PHYSICS

Advanced placement in the technical physics course would be based upon the following criteria:

Successful completion, with an A or B grade, of a course in a recognized, advanced placement high school course, along with at least a B grade on its associated standardized exam. Recommendation of a high school instructor is also required.

TECHNICAL MATH 111

Discussion included the possibility of accepting credit only from advanced placement courses in high school.

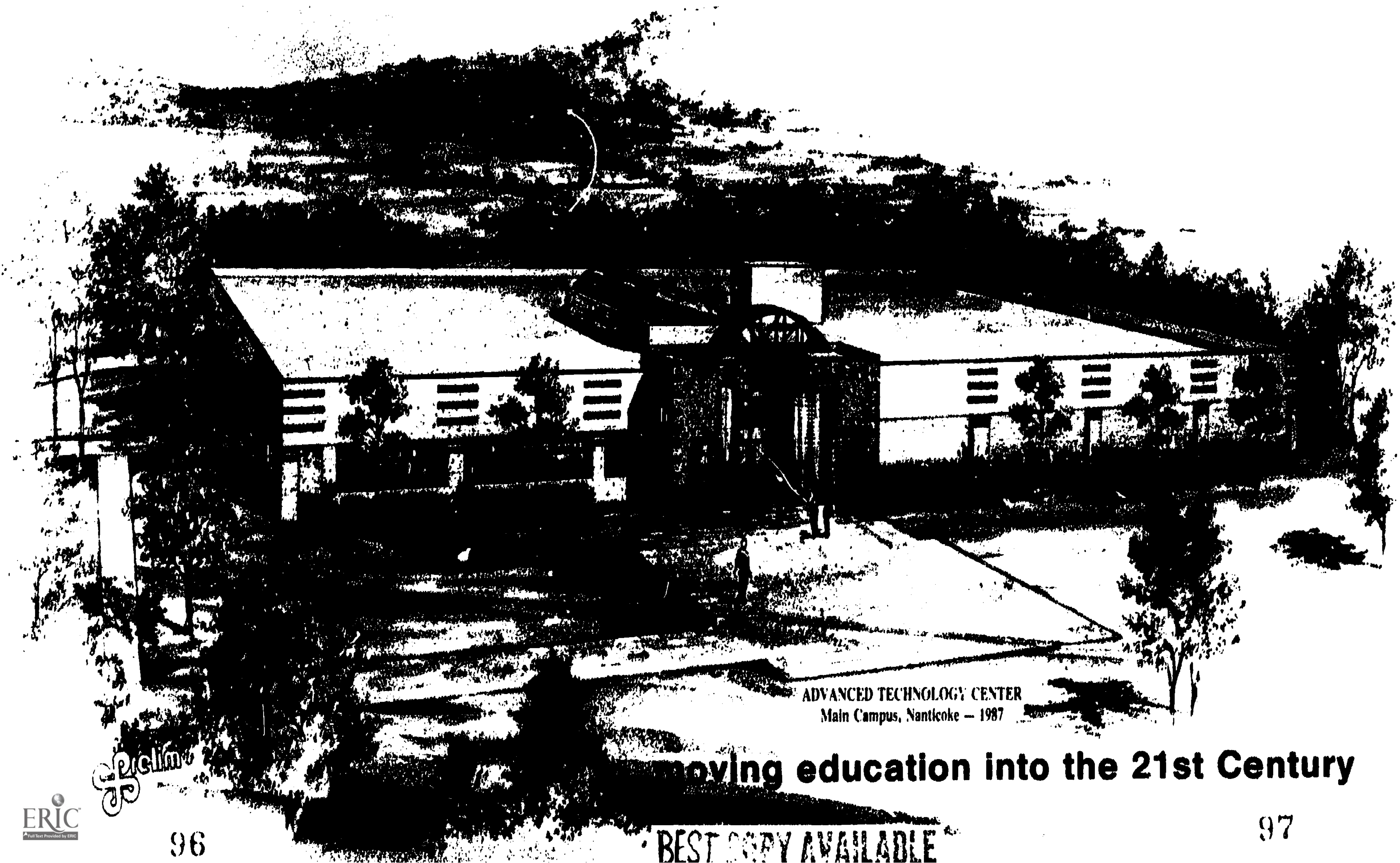
In the event that a student has not taken advanced placement courses in high, an alternative method of screening for awarding of advanced placement was explored. It would include the following steps:

1. Interview with counselor/college representative during which the student's background is explored with respect to requirements of the course.
2. Recommendation of the appropriate high school instructor.
3. Demonstration of completion of the prerequisite courses in high school. For example, electronics students must have completed algebra I and II, trigonometry, and physics before being considered for advanced placement in math or electronics courses.
4. Documentation of any relevent experience.
5. Formal testing in the course must result in a minimal score of ______.

ATTACHMENT #3

Advanced Technology Center Brochure

Community College of Luzerne County



ADVANCED TECHNOLOGY CENTER
Main Campus, Nanticoke — 1987

oving education into the 21st Century

fulfilling our mission . . .

Luzerne County Community College over its two decades of service to the region has developed strong programs in technical-career education and training. Follow-up studies show that the students that have been served by these programs have been well prepared to compete in the region's job market. In a continuing effort to fulfill the College's mission, and to maintain the marketability of our constituents, a major new initiative has been identified. A decision was made in 1986, after an assessment of regional manpower needs and emerging manufacturing process, to expand technical-career offerings into the areas of the advanced technologies to better position the College to support the careers of tomorrow and to foster community and regional economic development.

The intent of this new initiative is to attract new industries and to support existing enterprises which will add to the stability and health of the manufacturing and business communities in Northeastern Pennsylvania.

Fulfillment of this commitment will be accomplished through the development of an Advanced Technology Center (ATC) which will be dedicated to and designed for a wide array of new and upgraded programs that will provide the foundations for careers of tomorrow. ATC programming will be designed to support the identification, selection, and implementation of new technologies. The ATC will play a vital role in economic development by providing companies with a central source for help in applying the new technologies to their operations as well as providing a pool of trained personnel to meet manpower needs. This facility will feature new programs in areas including computer-aided manufacturing, laser-electro optics, computer systems maintenance, computer-assisted design, robotics, computer-aided drafting, automotive technology and broadcast telecommunications.

A strong design feature of the ATC will be built-in structural flexibility to respond to manpower needs as currently identified as well as those that will emerge in the future. The ability to eliminate, modify, add, or customize a specific training program within an extremely short time frame is of utmost priority to the College and to the region.

Finally, development of the ATC has grown out of the belief that continued regional economic growth requires government, business and education cooperation. The need to integrate new technical resources challenges all of us to come to grips with new technology and innovation. This new initiative will foster and encourage new partnerships to work together for a better tomorrow.

more than a building . . .

An Advanced Technology Center (ATC), as we should define it, is more than just a building . . . it's a CONCEPT. Involved with the concept are the following elements:

Credit (certificate/degree) program instruction:

- Telecommunications (Broadcast Communications)
- Automotive Technology
- Architectural Engineering Technology
- Mechanical Engineering Technology
- Electrical/Electronics Technology
- Computer Integrated Manufacturing Technology
- Automated Systems/Robotics Technology*
- Computer Assisted Design Technology*
- Computer Systems Maintenance Technology*
- Laser/Electro-Optics Technology
  Computer Numerical Control Technology
- Nuclear Power Technology

* May develop as **options** of other programs.

In the above-listed programs, the objective will be to produce a well-balanced, technical person capable of assisting architects, engineers, and other technology experts in a variety of support functions, to include, for example, designing and maintaining various design and manufacturing systems.

In the individual/business setting, this person will be somewhere on a level between the design and production stages of the manufacturing processes. This person will be the "troubleshooter" - the one with the **practical** knowledge of what needs to interact with what in what way to produce a product. Yet, this person will also have enough backgrounds (credits) to pursue advanced degrees, beyond the associate level.

These programs will be primarily competency-based, and will be delivered utilizing a variety of instructional approaches, including inter-active video, and computer-assisted instruction. The pool of available students will include recent high school graduates interested in seeking a degree or certificate, and adults interested in upgrading skills and/or changing careers.

Short-Term training

As technology continues to advance and change, especially in the Northeast corridor (regional scope - 20 county area), short-term training (10 to 25 hr. range) will become increasingly important in order for the private sector to keep employees (especially production personnel) current regarding new processes and new equipment. For the most part, this short-term activity will be of a custom-designed nature . . . a blend of standard pedagogical methodology and innovative delivery approaches with **new** content (subject matter).

The ATC will be the setting for a host of initiatives connected with custom-designed, short-term training . . . especially where equipment manufacturers located outside the region will need to provide training to local manufacturers *as a condition of the sale of equipment*. In this regard, the ATC will become the training site and/or location for equipment manufacturers like Cincinnati-Milicron, Allen-Bradley, Bridgeport, General Electric, etc. to do outreach regionally. The College's role in this process will be to provide space, interface with the training activity, and obtain, as a result (consequence), donated equipment. The spin-offs from this activity, in terms of benefits to the College, are impossible to clearly identify at this writing, but it seems logical to think they will be significant.

Contract Training

As technology advances in our region, the private sector will be in need of specific training to up-grade and advance the skills of employees. Remembering that the Northeast has an **older** work force, it seems logical to assume that rather than engage in union-difficult, lay-off strategies, companies in the private sector will be looking for means to "bail them out" of the problem of re-training with reasonable cost.

Contract training, i.e., educational programming and support services specifically geared to the re-training needs of a particular manufacturing process or company should be the answer to many prayers in the private sector. This type of training will be in the 100 hr. to 500 hr. range, delivered in the ATC and/or on site (of the company) in various fashions—and designed and delivered in such manners as to address an immediate training need, while, at the same time, having application in some manner to existing (degree) programs.

Technology Exchange

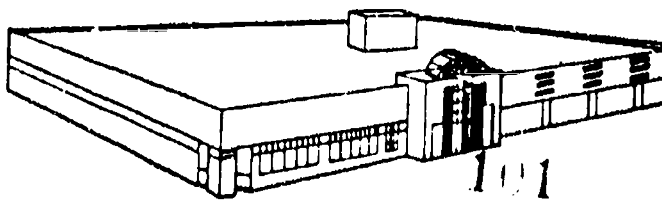
While definitely connected to short-term training, this ATC element can be of great significance in providing the setting for existing, regional companies (and local ones) to view and examine new technological advances—the actual equipment, not just pictures or catalog cuts. Displays and exhibitions, either as stand-alone activities, or in conjunction with workshops and seminars (5 hr. to 10 hr. duration) will be important to the development of the ATC as a highly visible community/private sector resource, and important to the educational conference center as a focus for private sector thrusts (fund-raising).

Other Considerations

The Institute has already conducted a very successful "Incubator Without Walls" project under a grant from Sears PDF/KAW-AACJC. The Sears project, as it is affectionately known, has garnered many plaudits and acknowledgements as a unique, effective approach to assisting new, fledgling companies. We need to do more of the same, and this kind of activity can be continued through the application of the ATC concept.

The private sector in our region has many needs . . . and needs to be supported and assisted, especially existing small and moderately sized businesses/companies.

The ATC is more than just a building; it is a jumping-off point for a venture into the future that should be on-going well into the next century. Because of what the ATC is and will do, the very foundation upon which the College was founded—to address the changing needs of the community (with the emphasis on "changing")—this foundation should be bolstered tremendously.



Committed to the introduction of new technology into the workplace, the ATC is both market driven and business responsive. In building and expanding its role as a technology resource, the ATC will carefully focus on an agenda tailored to increasing productivity, improving product quality, enhancing employee skills, and helping Northeastern Pennsylvania companies gain and maintain a competitive status.

The 85,000 sq. ft. Center will offer:

- Comprehensive teleconference facilities.
- Exhibition space for technology systems and demonstrations supported by furnished office and reception suites for customer meetings and business transactions.
- Many individual computer workstations permitting self-paced instruction to support custom-designed training delivery.
- Dedicated computer training labs.
- On-site media support systems.
- Seminar and meeting rooms with audio-visual support.
- Climate controlled manufacturing process lab with 20 stations.
- Fluid Power Lab with 24 stations.
- A robotics lab with three cells featuring the latest automatic machinery.
- Computer Integrated Manufacturing (CIM) lab.
- Computer aided drafting lab.
- Laser lab.
- Six auto-labs.

Here, in one location, businesses can find many of the services needed to integrate modern technology into their operations.

Upper Level

☐ Offices
- Administrative
- Faculty

☐ Technology Training and Demonstration
- Large Group/Demonstration
- Small Group Seminar

☐ Lobby/Display and Exhibition

☐ Broadcast Communications Facility
- FM Radio Station Studio/Control
- Audio Production/Editing
- Video Production/Editing
- TV Production Studio
- TV Production Control

■ Instructional Laboratories
- Electrical Machines
- AC/DC
- Microprocessor
- Mechanical Drafting
- Architectural Drafting

☐ Restrooms, Elevator, Stairways

☐ Classrooms

Lower Level

☐ Offices
- Faculty

☐ Lobby/Display and Exhibition

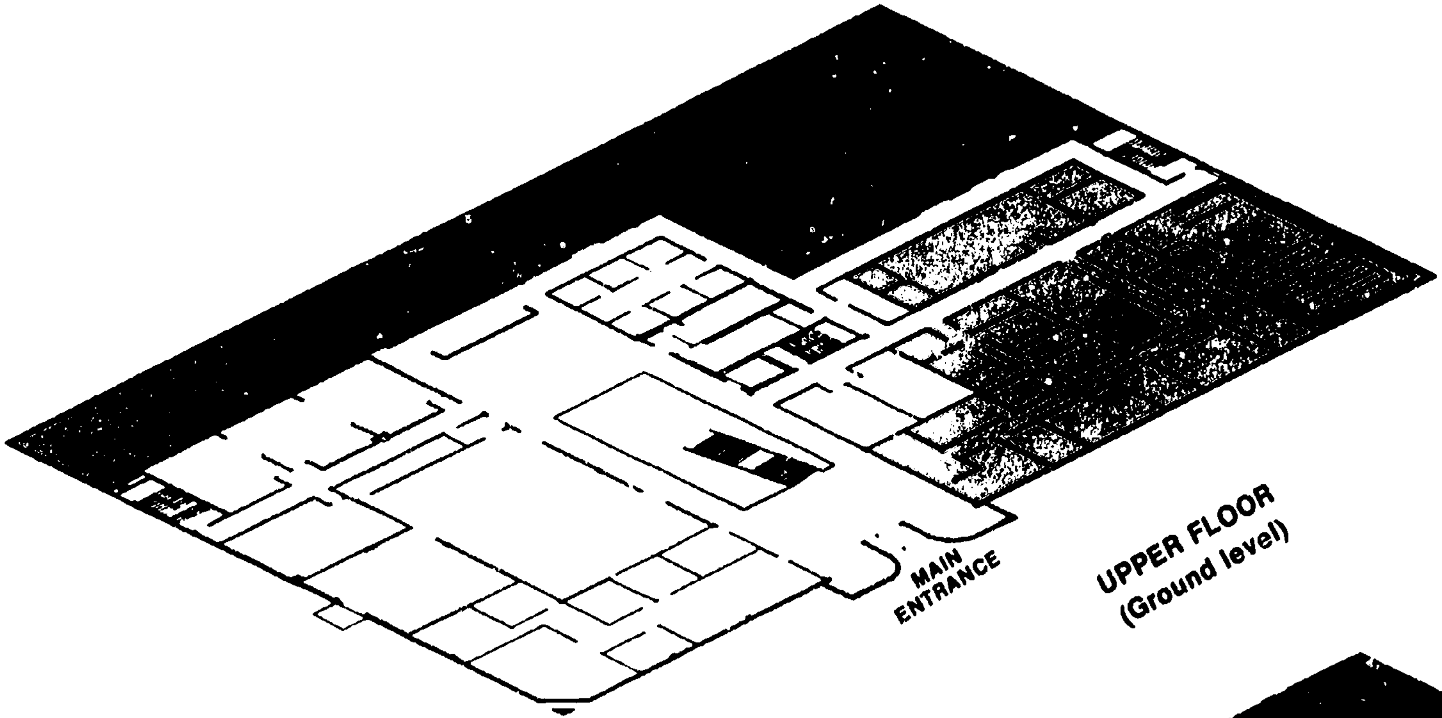
■ Instructional Laboratories
- Laser
- Automotive
- Manufacturing Processes
- Computer Integrated Manufacturing
- Computer Aided Drafting
- Fluid Power
- Robotics
- Technical Equipment Service

☐ Classrooms

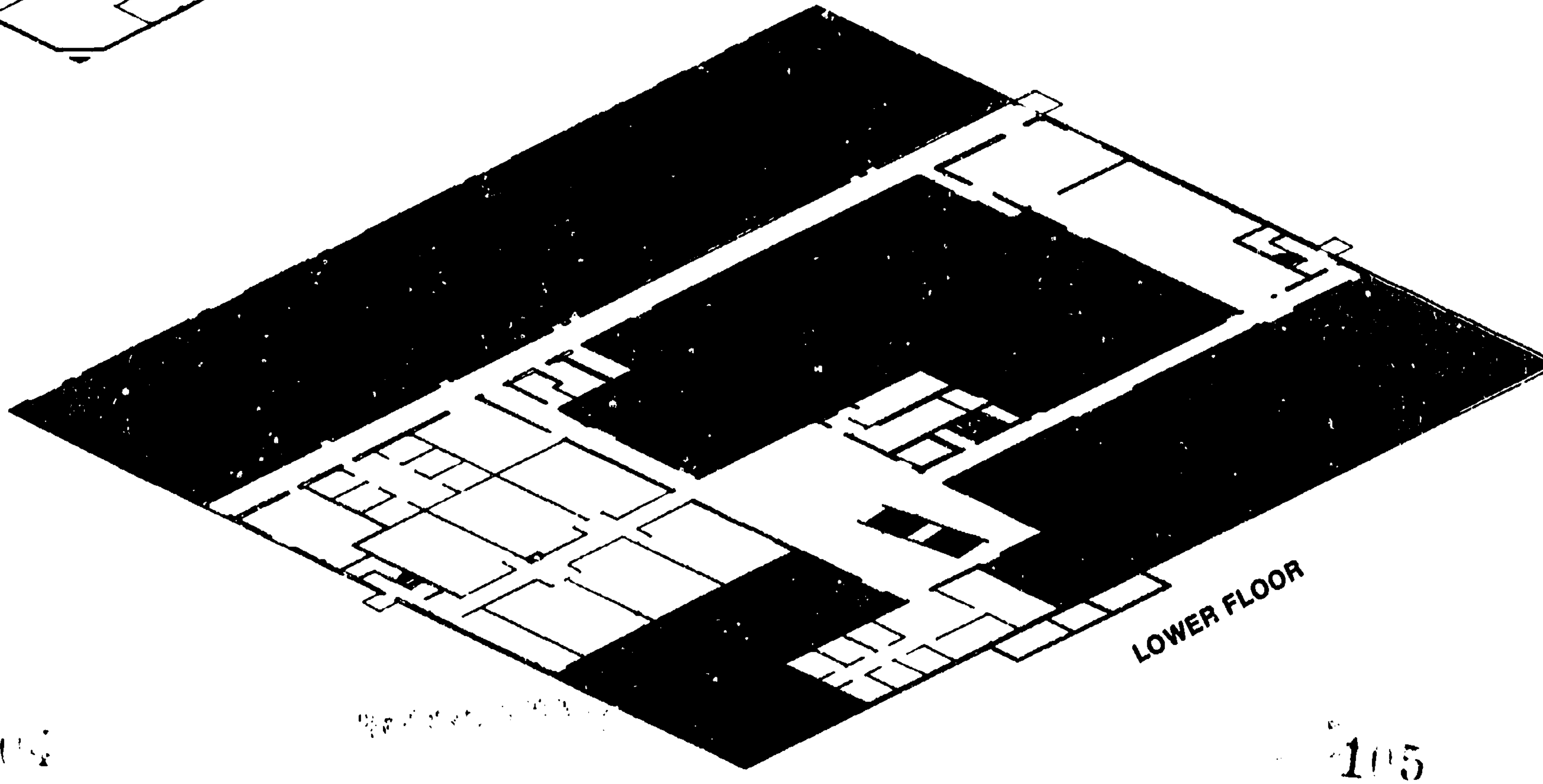
☐ Receiving, Staging, and Exhibition

☐ Restrooms, Elevator, Stairways

☐ Broadcast Communications Facility



UPPER FLOOR
(Ground level)



LOWER FLOOR

opportunities in high technology . . .

BROADCAST COMMUNICATIONS TECHNOLOGY

This two-year associate degree program utilizes a "hands-on" approach, whenever feasible, to provide the student with a comprehensive understanding of the theory and skills vital in the broadcast medium, as well as the private and corporate communications fields. An emphasis is placed on student competency in the operation of advanced technology equipment in audio and video production, and in the latest computer graphics video system.

AUTOMOTIVE TECHNOLOGY

The Automotive Technology program is a two-year associate degree program which offers both theory and practical experience combined. Students enrolled in the program will acquire a comprehensive understanding of the theory and skills necessary to diagnose, service and repair automotive systems and components utilizing varied computer systems/technology.

ARCHITECTURAL ENGINEERING TECHNOLOGY

The College offers both a one-year certificate and a two-year associate degree program in Architectural Engineering which prepares students for employment opportunities as technicians in the field. In addition to positions with architectural firms, the student may also qualify as an engineering aide, architectural draftsman, assistant surveyor, detailer, building materials and equipment salesman or estimator.

MECHANICAL ENGINEERING TECHNOLOGY

This curriculum is offered in both a one-year certificate or two-year associate degree program and is designed to prepare students for work in industry as an engineering technician, and for advancement to group leader or foreman. The program includes the basics in humanities, social sciences, applied math and physics, and appropriate technical courses.

ELECTRICAL/ELECTRONICS TECHNOLOGY

The Electrical/Electronics Technology program is offered in both a one-year certificate program and a two-year associate degree program. The two-year program emphasizes both the theory and the practical applications of electrical/electronics which is in line with the rapid changes in this extremely diversified field which requires competency in a broad range of fundamentals.

The one-year program enables students to develop the specialized skills necessary to design, install, service, and operate electrical/electronic equipment.

COMPUTER INTEGRATED MANUFACTURING TECHNOLOGY

Both a one-year certificate and two-year associate degree program are being developed for this program which will train technicians for employment in modern computerized manufacturing industries. Such technicians produce production parts by using computer-controlled machine tools and similar sophisticated equipment.

Employment in the field of automated manufacturing is expected to increase faster than the average for all occupations through the 1990's.

AUTOMATED SYSTEMS/ROBOTICS TECHNOLOGY

This two-year associate degree program is designed to provide students with the knowledge and practical experience for electromechanical equipment and controls common to both robotic and automated systems.

COMPUTER SYSTEMS MAINTENANCE TECHNOLOGY

This two-year associate degree program is a specialty concentration within the broader scope of the Electronics Engineering Technology program. The complexity and scope of the internal functions of the microcomputer as well as its wide variety of associated peripherals, instruments and systems, requires high academic capacity as well as technological/manipulative skills.

LASER/ELECTRO-OPTICS TECHNOLOGY

This two-year associate degree program will emphasize the theory and applications of Laser/Electro-Optical technology. A broad based knowledge of electronics, optics, and lasers is required for competency in this emerging technology.

NUCLEAR POWER TECHNOLOGY

This two-year associate degree program is designed to provide technically trained personnel to support the nuclear power industry. The objective of the program is to provide students with a comprehensive understanding of the theory and skills necessary to function in one of the following areas — reactor operations, instrumentation and control, and health physics.

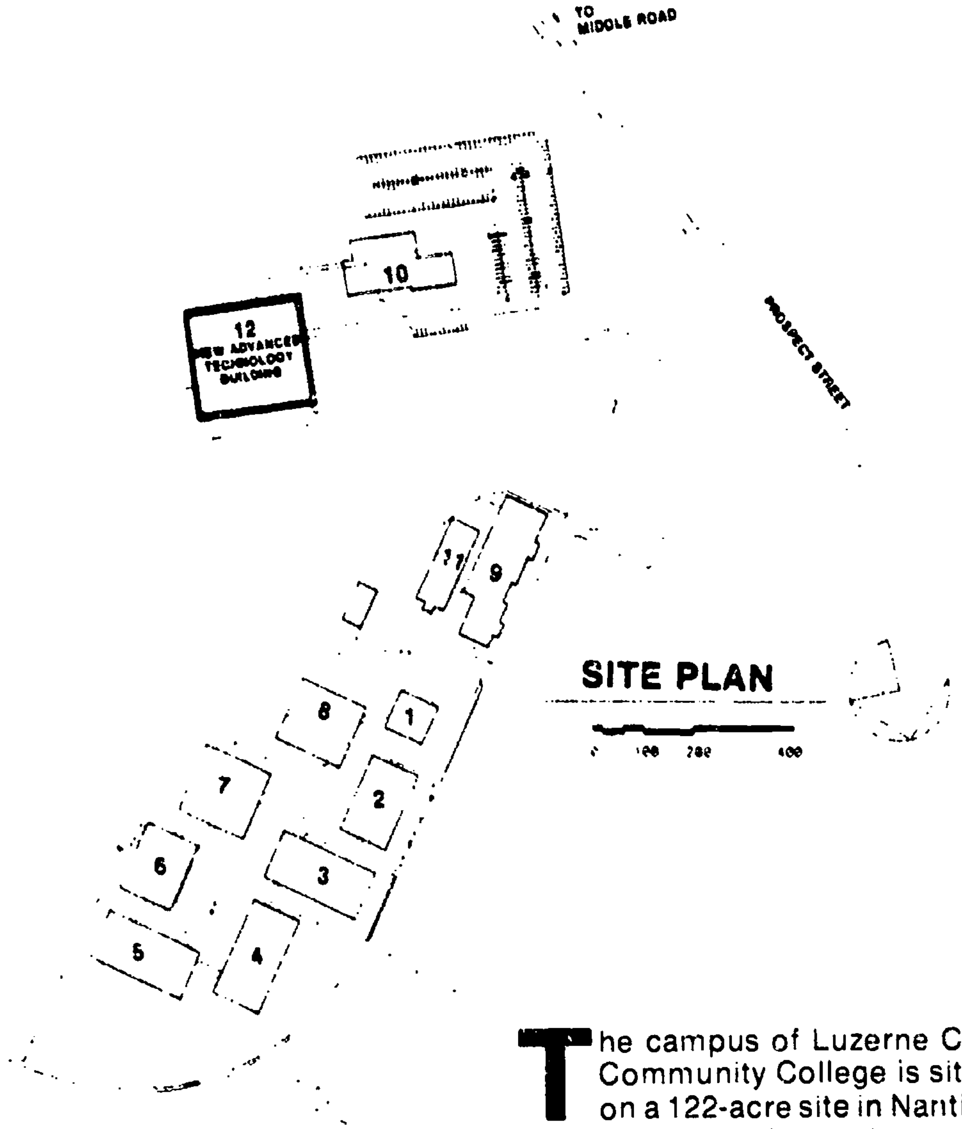
COMPUTER AIDED DESIGN (CAD) TECHNOLOGY

This two-year associate degree curricuum is designed to provide students with a working knowledge of micro and mainframe CAD systems. It also introduces basic and advanced drafting and design done on computers as well as basic programming and automated systems concepts.

COMPUTER NUMERICAL CONTROL TECHNOLOGY

The Computer Numerical Control (CNC) Technology curriculum, which is a two-year associate degree program of study, emphasizes the use of current computerized numerical control and computer aided manufacturing technologies to program machine tools to perform drilling, milling, and turning operations. Instruction emphasizes hands-on skills as well as related information.

. . .in a perfect setting



The campus of Luzerne County Community College is situated on a 122-acre site in Nanticoke. Pennsylvania. Of the eleven buildings the **General Academic Building (#4)** and the two **Technical Arts Buildings (#2 and #3)** contain classrooms. laboratories. and faculty offices. Recently completed was the **Medical Arts Complex (#9)**, consisting of a dental arts facility, a nursing arts facility and a multipurpose facility

The Student Center Building (#7) houses student lounges, a dining-vending rea, the College Bookstore, the College Health Office, and student activity offices.

The **Health and Physical Education Building (#8)** includes a two-station gymnasium. and a training area The **Administration Building (#5)** houses the majority f the College s Administrative services, plus the Programmed Study Center.

The **Physical Plant Services Building (#1)** contains a warehouse. and repair shops The **Instructional Resource Center (Library) (#6)** contains study areas, periodical and reference areas. archives, and facilities for the College's book collections

The **Educational Conference Center (#10)**, includes six seminar rooms. two auditoriums and a spacious dining area

ewest facility a **Faculty Office and Classroom Building (#11)**, contains 46 offices a secretary-reception area, and five classrooms.

The Educational Conference Center has been designed to meet the needs of outside agencies, businesses and organizations for meetings, seminars and conferences. Seven various size seminar rooms and two auditoriums offer the needed flexibility in preparing for a successful learning experience. The attractive, spacious dining area provides for all day or meal-centered activities. All of the latest electronic and communication equipment, including a satellite receiving station, is available.

A professional coordinator and staff are available to answer your every need. The College is pleased to offer its comprehensive conference planning program to area residents at the most reasonable price possible.

Credits

Robert P. Casey, Governor
Commonwealth of Pennsylvania

Thomas K. Gilhool
State Secretary of Education

Luzerne County Board of Commissioners
- Frank Trinisewski, Chairman
- Jim Phillips
- Frank Crossin

Thomas J. Moran, President

John Hosage, D.D.S.
Chairman, Board of Trustees

John M. Beccaris
Dean of Institutional Development and College Project Officer

Pyros and Sanderson
Architect

Sordoni Construction Company
Construction Manager

Pauline G. Carmody, Assistant to President/External Affairs

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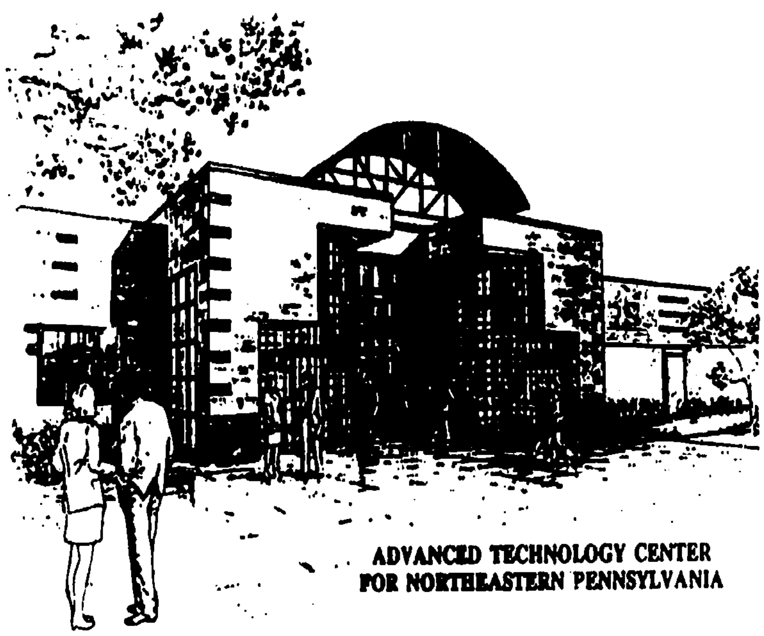
ATTACHMENT #4

Program Brochure

Laser/Electro-Optics Technology



Community College of Luzerne County

. . . moving education into the 21st Century

Laser/Electro-Optics Technology

Laser technicians can be found in many industries. In hospitals, they maintain and adjust the intensity of the laser beam penetration for surgical procedures. The technician couples the laser to a robot in automated manufacturing for welding, drilling and cutting metal. The lasers in supermarkets and libraries are serviced by laser technicians.

Technicians may be involved in laser assembly and production; maintenance and operation; troubleshooting and repair; research and development; or sales and service in a number of areas.

Should you enroll in LCCC's Laser/Electro-Optics Technology program?

If you enjoy electronics, science, math, and, working with your hands, Laser/Electro-Optics may be for you. The program's emphasis on practical hands-on experience will help you develop your interest in electronics and technology into rewarding employment skills.

What are your job and salary opportunities as a graduate of LCCC's Laser/Electro-Optics Technology program?

Starting salaries range from $15,600 to $18,200 per year in Eastern Pennsylvania. Experienced technicians average about $26,000 per year depending upon your background and experience.

Associate Degree Program

1st Semester			*Semester Hours*
LEO	101	Introduction to Lasers	4
MAT	111	Technical Mathematics I	5
IEL	131	D.C. Electricity	4
ENG	101	English Composition I	3
			16

2nd Semester			*Semester Hours*
LEO	102	Laser Optics	4
MAT	112	Technical Mathematics II	5
IEL	132	A.C. Electricity	3
PHY	123	Technical Physics I	4
			16

3rd Semester			*Semester Hours*
LEO	201	Laser Equipment and Measurements	4
IEL	135	Electronic Devices	3
PHY	124	Technical Physics II	4
SPE	125	Fundamentals of Speech	3
GET	234	Intro. Computer Program.	3
			17

4th Semester			*Semester Hours*
LEO	202	Laser Appli. & Projects	4
IEL	205	Digital Circuits	3
		Social Science Elective	3
ENG	261	Technical Report Writing	3
IEL	201	Elect. Amplifier Circuits	3
HPE		Health/Physical Education	1
			17

Other Education & Training Options

Short-term training (10-30 hours), workshops, seminars, and customized training for business and industry are available on a scheduled basis and by request. Call the Executive Director of the Advanced Technology Center for more information at 829-7300.

Please send me information on each category or area of study checked below:

☐ Admissions Procedures
☐ Advanced Placement Procedures

Advanced Technology Center Programs

☐ Automotive
☐ Architectural Engineering
☐ Automated Systems/Robotics
☐ Broadcast Communications
☐ Computer Assisted Design
☐ Computer Integrated Manufacturing
☐ Computer Numerical Control
☐ Computer Systems Maintenance
☐ Electrical/Electronics
☐ Laser/Electro-Optics
☐ Mechanical Engineering
☐ Other Training (please specify)

____

____

Name ______________________________

Street ______________________________

City ____________ State ________ Zip ________

Telephone Number ______________________________

____

Luzerne County Community College does not discriminate on the grounds of race, color, national origin, sex, age or handicap in the administration of any of its educational programs, activities or employment in accordance with applicable federal statutes and regulations. Inquiries concerning application of this policy should be directed to Susan Fay, Office of Affirmative Action/Employee Relations, Prospect Street and Middle Road, Nanticoke, PA 18634 (Phone 717-829-7393)

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POSTAGE WILL BE PAID BY:

Advanced Technology Center
Community College of Luzerne County
Prospect Street & Middle Road
Nanticoke, PA 18634-9987

Here's How To Apply For LCCC's Advanced Technology Programs

1. You may call 829-7343 or visit the Admissions Office to obtain an application, or go to your local high school guidance office. The Admissions Office at the Community College is located in Building 5 (Administration Building).
2. Have your high school transcripts or GED scores and your completed application for admission sent to the college's Admissions Office.
3. The college will contact you regarding your program of study.
4. An interview is not required, but may be scheduled to obtain additional information. Please call 829-7343 or 459-1600 for more information.

You May Qualify For Financial Aid

At LCCC, several types of financial aid may be available to you. You may apply for federal and state grants that do not have to be repaid. A number of scholarships also are available.

Other options you may want to consider are loans and student employment — both on and off campus. LCCC does not turn students away because of financial need. Let us work with you to make college affordable.

Call LCCC's Financial Aid Office for detailed information at 735-8300, 829-7300, or 459-1600 extension 389.

FOR MORE INFORMATION

Wesley E. Franklin, Executive Director
Advanced Technology Center
for Northeastern Pennsylvania
Community College of Luzerne County
Nanticoke, Pennsylvania 18634-3899

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ATTACHMENT #5

LASER/ELECTRO-OPTICS

EQUIPMENT SPECIFICATIONS

1. Laser/Electro-Optics Laboratory Accessories and Components.
2. Laser/Electro-Optics Laboratory - Major Equipment

LUZERNE COUNTY COMMUNITY COLLEGE

1 mW Helium Neon Laser System

Quantity: 4 | Location: **Laser Lab**

Description:

1 mW Helium neon laser system having the following characteristics:

- -minimum output power (mW, TEM_{00}, 633nm) = 1.0 mW
- -beam diameter at $1/e^2$ = 0.48 mm
- -beam divergence = 1.7 mrad
- -minimum polarization ratio = 500:1
- -longitudinal mode spacing = 1070 MHz
- -beam pointing stability from cold start (25°C) <0.10 mrad, after 15 minute warm-up < 0.01 mrad
- -CDRH Class IIIa

UNIPHASE MODEL 1507 or equivalent

MODEL PROPOSED________________________________

UNIT PRICE____________________ TOTAL COST____________________

LUZERNE COUNTY COMMUNITY COLLEGE

Autocollimator

Quantity: 1 Location: Laser Lab

DESCRIPTION

Autocollimator having following characteristics:

Resolution: 5×10^{-5} rad. (3 arc sec)

Objective: focal length 160 mm, working aperture 2 to 30 mm, focus fixed at infinity, controlled by iris diaphragm.

Ocular: linear magnification 20 x, rotation of the mirror (+/-2 deg.). field 15 mm.

Eyepiece reticule: fixed cross hairs covering the whole field, thickness of the cross hair being 10 micrometers.

Lighting: axial.

KLINGER SCIENTIFIC MODEL 115003 or EQUIVALENT

Total cost to include delivery, set up, and one day training.

Model Proposed______________________________________

Single Item Cost____________________Total Cost________________

LUZERNE COUNTY COMMUNITY COLLEGE

Optical Table with Vibration Isolation Support System

Quantity: 2 of each item Location: Laser Lab

Description:

Optical table, laminated steel type with vibration isolation support system. Unit to consist of the following:

1.) Table Top, laminated steel, honeycomb optical table, 4 feet x 8 feet table with 12 inches thickness, rigid and damped. Top to be ferromagnetic stainless steel with 1/4 -20 tapped holes 2 inches on center. Must include laser port.
EALING MODEL 37-8588 or equal

1.) Vibration Isolation Support for optical table with floor stand.
EALING MODEL 24-5225 or equal

1.) Laser Shelf which mounts to the underside of the 12 inches thick table. Shelf made from laminated steel same as optical table. Measures 2 feet x 4 feet.
EALING MODEL 24-5969 or equal

Total cost to include inside delivery.

Model Proposed____________________

Single Item Cost____________ Total Cost____________

LUZERNE COUNTY COMMUNITY COLLEGE

Optical Table with Vibration Isolation Support System

Quantity: 3 of each item   Location: Laser Lab

Description:

Optical table, laminated steel type with vibration isolation support system. Unit to consist of the following:

1.) Table Top, laminated steel, honeycomb optical table, 4 feet x 8 feet table with 8 inches thickness, rigid and damped. Top to be ferromagnetic stainless steel with 1/4 -20 tapped holes 2 inches on center. Must include laser port.

EALING MODEL 37-9230 or equal

1.) Vibration Isolation Support for optical table with floor stand.

EALING MODEL 24-5225 or equal

1.) Laser Shelf which mounts to the underside of the 12 inches thick table. Shelf made from laminated steel same as optical table. Measures 2 feet x 4 feet.

EALING MODEL 24-5969 or equal

Total cost to include inside delivery.

Model Proposed ____________________

Single Item Cost ____________________ Total Cost ____________________

LUZERNE COUNTY COMMUNITY COLLEGE

35mW Helium-Neon Laser

Quantity: 1 Location: Laser Lab

Description:

35mW output power Helium-Neon Laser to have the following characteristics:

Output Power -- 35mW
Wavelength -- 632.8nm
Transverse mode -- TEM oo
Polarization Extinction Ratio -- 500:1
Angle of Polarization -- Horizontal +/- 5 deg.
Beam Diameter at $1/e^2$ Points -- 1.25 +/- 0.10mm
Beam Divergence -- 0.66 +/- 0.05mrad
Beam Waist Location -- outer surface of output mirror

Static Alignment:

Beam Pointing Tolerance -- +/- 6mrad
Beam Position Tolerance -- +/- 2.3mm

Operating Stability:

Beam Pointing -- < 0.2mrad
Beam Position -- < 0.05mm

Electrical Requirements:

Voltage -- 90-130/180-260 Vac
Current -- 1/0.5 A
Frequency -- 50-60 Hz

Spectra-Physic Model 127-35 or Equivalent

Model Proposed____________________

Single Item Cost____________ Total Cost__________

LUZERNE COUNTY COMMUNITY COLLEGE

Multimeter, digital type, portable

QUANTITY: 5 of each item | LOCATION: Laser Lab

Item Description:

1 Multimeter, digital type, portable having the following characteristics:

- 4 1/2 digits and microprocessor based
- basic dc accuracy = 0.03%
- provides digital read-out of decibels referenced to any one of sixteen imped ces from 8 ohms to 1200 ohms
- five voltage ranges = ± 200 mV, ± 2 V, ± 20 V, ± 200 V, and ± 1000 V
- resolution = 10 µV on lowest range, 0.1 V on 1000 V range
- true rms from 20 Hz to 50 KHz
- nine functions to include relative reference, dB, dBm, dBV, dBW (8 ohms), conductance. Diode test.

FLUKE MODEL 8050A OR EQUIVALENT

Accessories to Accompany Portable Digital Multimeter

Item Description:

1 Test Lead Kit to include the following:

a black and a red insulated wire lead
- two insulated alligator clips
- two spade lug tips
- a spring loaded hook tip
- two probes with solid metal pin tips, finger guards, and pouch

FLUKE MODEL NUMBER Y8134 OR EQUIVALENT

Item Description:

1 Soft Carrying case having the following characteristics:

- a soft vinyl plastic container designed for the storage and transport of the Portable Digital Multimeter
- a separate storage compartment for test leads and other accessories

FLUKE MODEL NUMBER Y8205 OR EQUIVALENT

MODEL PROPOSED ____________________

UNIT PRICE ____________________ TOTAL COST ____________________

LUZERNE COUNTY COMMUNITY COLLEGE

Coaxial Cables with BNC Connectors

Quantity: 12

Location: Laser Lab

Description:

Coaxial cables with BNC connectors, 42" long

TEKTRONIX MODEL NUMBER 012-0057-01 or equivalent

MODEL PROPOSED____

UNIT PRICE____________________ TOTAL COST____________________

LUZERNE COUNTY COMMUNITY COLLEGE

AC TRANSFORMER

Quantity: 1

Location: Laser Lab

Description:

AC transformer which provides voltages of 2 to 12 Vac. in two volt steps. It will supply 100 watts of power at any setting. A convenient source of power for the Blackboard Optics ray projectors.

PASCO MODEL NUMBER SE 9197 or equivalent

MODEL PROPOSED______________________________

UNIT PRICE____________________ TOTAL COST____________________

LUZERNE COUNTY COMMUNITY COLLEGE

Electroformed Slits

Quantity: 5

Location: Laser Lab

Description:

Electroformed slits (±5 micron tolerance): a complete set of 16 slits on 4 slides

PASCO MODEL NUMBER OS-9165 or equivalent

MODEL PROPOSED________________________________

UNIT PRICE____________________ TOTAL COST____________________

LUZERNE COUNTY COMMUNITY COLLEGE

Helium Neon Laser Mirrors

QUANTITY: 4 sets LOCATION: Laser Lab
(each set includes both high reflector and output coupler mirrors)

Description:

4 sets of Helium Neon Laser mirrors. Each set consists of:

1 High reflector HeNe mirror for 633 nm wavelength and 7.75 mm diameter

Spectra-Physics model G3801-001 or equivalent

1 Output coupler HeNe mirror for 633 nm wavelength and 7.75 mm diameter

Spectra-Physics model G3801-002 or equivalent

MODEL PROPOSED______________________________

UNIT PRICE____________________ TOTAL COST____________________

LUZERNE COUNTY COMMUNITY COLLEGE

Complete Suction Mount Blackboard Optics System

Quantity: 1 (includes each of the following items) Location: Laser Lab

Description:

Complete suction mount blackboard optics system to include:

2	Ray projector
2	Holder for projector
2	Clamping bar, 13"
1	Clamping bar, 15"
1	Plano convex lens
1	Plano concave lens
1	Semicircular lens
1	Rectangular block
1	Prism, right angle
2	Plane mirror
1	Curved mirror, double
1	Projector lamp, spare
1	Cushioned storage cabinet
1	Flint glass prism
1	Projection screen
1	Screen holder
1	Grating (replica, 6000/cm)
1	Grating holder
1	Set of color filters
1	Double slit
1	Equilateral prism

1 Planoconvex lens

1 Planoconcave lens

1 Planoconvex lens, long focus

1 Multiple-ray projector

1 Replacement lamp for above

2 13" clamping bar

PASCO MODEL NUMBER SE 9199 or equivalent

MODEL PROPOSED____________________________________

UNIT PRICE____________________ TOTAL COST____________________

LUZERNE COUNTY COMMUNITY COLLEGE

100 MHz Dual Trace Oscilloscope with Counter/Timer/Multimeter

Quantity: 3 Location: Laser Lab

Description:

Vertical System

Bandwidth(-3dB) and Rise Time: 100 MHz and 3.5nsecond.

Bandwidth Limit: 20 MHz +/-10%

Deflection Factor Accuracy: 2mV to 5V/div. at +/- 2%

Step Response Aberrations: +4%, -4%, 4% p-p (5mV to 0.5V/div), +5%, -5%, 5% p-p (2mV/div)

Display Modes: CH1, CH2, CH2 Invert, Add, Alternate, chop (500KHz)

Common-Mode Rejection Ratio: At least 10:1 at 50MHz for signals of 6 div or less

Input R and C: 1MΩ, 22pF

Maximum Input Voltage: 400V (dc+ peak ac) or 800V (p-p to 10KHz)

Channel Isolation: 100:1 at 50 MHz

Horizontal System

Time Base: 0.05µsec to 0.5 sec/div in 1-2-5 sequence. Sweep Linearity: +/- 5% over any two of center eight divisions.

Display Modes: A, Alternate (A Intensified and B delayed) and B.

Triggering

A Trigger Sensitivity:

Internal: 10 MHz, 0.35 div
External: 10 MHz, 40 mV
Internal: 60 MHz, 1.2 div
External: 60 MHz, 150mV
Internal: 100 MHz, 1.5 div
External: 100 MHz, 250 mV

B Trigger Sensitivity:

Internal: 10 MHz, 0.4 div
60 MHz, 1.2 div
100 MHz, 1.5 div

TV Trigger Sensitivity -- TV Field: 1.0 div of composite sync.
TV line: 0.35 div

Trigger System Operating Modes -- Normal, p-p automatic, TV line, TV field, and single sweep.

x-y operation

Deflection Factors -- same as vertical system

Accuracy -- y-axis (+15 to +35 deg C) : +/- 2%
y-axis (0 to + 50 deg C) : +/- 3%
x-axis (+15 to +35 deg C) : +/- 3%
x-axis (0 to +50 deg C) : +/- 4%

Bandwidth -- y-axis: same as vertical system
x-axis: 2.5 MHz

CRT and Display Features

CRT - 8 x 10 cm display; internal unilluminated graticule

Controls - Beam Finder, Focus, Separate A and B Sweep
Intensity, Trace Rotation

Power Requirements

Line Voltage Range - 90 to 250V ac

Other Characteristics

Integrated Counter/Timer/DMM

Totalize - Over 8000000 events.

Multimeter Inputs - Isolated from oscilloscope ground.

Unit to have two 10x voltage probes; DMM leads; Reference Guide; Operator Manual; Service Manual

TEKTRONIX MODEL 2236 OR EQUIVALENT

Total cost to include delivery, set up, and one day training.

Model Proposed ______________________________

Single Item Cost ____________________ Total Cost ____________

LASER LABORATORY EQUIPMENT

QUAN	ITEM DESCRIPTION	EDMUND SCIENTIFIC MODEL NUMBER OR EQUIVALENT	MODEL PROPOSED	UNIT PRICE	TOTAL PRICE
10	Linear polarizers, 7" X 24", cut from 2 sheets	P70888			
5	Lab jacks, 6" x 6"	P36283			
5	Optical benches, triangular, one meter	P83008			
15	Carriers, triangular base, 60 mm width	P60796			
5	Helium spectrum tube, 10 cms long	P60907			
5	Neon spectrum tube, 10 cms long	P60910			
5	Spectrum tube power supply, 5000v, 7mA max. transformers	P71559			
5	Mercury Vapor spectrum tube, 10 cms long	P60908			
5	Student English micro-meter, 0.025 nm resolution	P60666			
5	Beam expanders, 52 mm diameter	P94757			
5	Linear translators, calibrated, 25 mm travel	P33489			
5	Fiber optic probe, 1/16" aperture diameter	P40640			
5	Magnifier, 12X, diameter 0.545", field of view ½", AR coated lens system, 1¼" height	P30055			
5	Carbon Dioxide spectrum tube, 10 cms in length	P60914			

QUAN	ITEM DESCRIPTION	EDMUND SCIENTIFIC MODEL NUMBER OR EQUIVALENT	MODEL PROPOSED	UNIT PRICE	TOTAL PRICE
5	60° equilateral prism, face size 32 mm, length 28 mm	P31053			
5	Broadband interference filters, 650 nm wavelength, 3/4" x 3/4" size	P30718			
5	Broadband interference filters, 600 nm wavelength, 3/4" x 3/4" size	P30715			
5	Broadband interference filters, 671 nm wavelength, 3/4" x 3/4" size	P30886			
5	Broadband interference filters, 405 nm wavelength, 3/4" x 3/4" size	P30704			
5	Broadband interference filters, 450 nm wavelength, 3/4" x 3/4" size	P30706			
5	Broadband interference filters, 505 nm wavelength, 3/4" x 3/4" size	P30755			
5	Broadband interference filters, 550 nm wavelength, 3/4" x 3/4" size	P30845			
6	Neutral density filters ½" x 1", optical density at 500 nm being 2.0	P30893			
1	Microscopic slides package, 1" x 3" quantity - 72	P40001			
1	Package of 500 sheets of lens tissue 7 3/4" x 3 1/4"	P60375			
6	Positive lens, 12 mm diameter, 18 mm F.L.	P32013			
6	Converging lens, 26 mm diameter, 5 cms F.L.	P94274			

QUAN	ITEM DESCRIPTION	EDMUND SCIENTIFIC MODEL NUMBER OR EQUIVALENT	MODEL PROPOSED	UNIT PRICE	TOTAL PRICE
6	Hemostats, made of stainless steel	P40571			
6	First surface mirrors, 8.2 cms diameter	P31003			
6	Diverging lens, 19 mm diameter, 18 mm F.L.	P32206			
12	Converging lens, 18 mm F.L., 12 mm diameter	P32006			
6	Prism, chromatic dispersion 25 mm face size	P31801			
6	Concave mirror, 25 mm F.L., 25 mm diameter	P42967			
6	Convex mirror, 62 mm F.L., 26 mm diameter	P42974			
6	Diverging lens, 2-4 cms F.L.	P95458			
12	Plate, glass 1/8" x 3" square	P31035			
6	Plano-convex lens, uncoated, 18 mm diameter, 36.0 mm effective F.L.	P32000			
6	Plano-convex lens, AR coated, 18.0 mm diameter, 36.0 mm focal length	P31857			
4	Variable-speed electric motor w/rotary disk that has six evenly-spaced cuts in it. Motor 7000rpm, 24v	P42543			
6	Second surface mirrors	P32230			
6	Mirrors, partially-reflective dielectric	P41960			

QUAN	ITEM DESCRIPTION	EDMUND SCIENTIFIC MODEL NUMBER OR EQUIVALENT	MODEL PROPOSED	UNIT PRICE	TOTAL PRICE
6	Right angle prism, Aluminized	P40995			
6	Amici roof prism	P3002			
6	Dove prism	P31055			
6	Converging lens, 6" F.L. 2" diameter	P94127			
6	Plano-convex lens, 38 mm F.L., 30 mm diameter	P94832			
6	Plano-convex lens, 25 mm F.L., 25 mm diameter	P32001			
6	Lens, diameter 38 mm, F.L. 49 mm	P96013			
6	Biconvex lens, 38 mm F.L.	P94800			
6	Biconvex lens, 10 mm F.L., 12 mm diameter	P32014			
6	Biconcave lens, 30 mm F.L. 12 mm diameter	P31835			
6	Wedge prism	P30265			
2 sheets	Polaroid H-type	P71942			
6	Lens, 10 cm F.L.	P94931			
5	Hydrogen spectrum tube, 10 cms in length	P60906			

ALL THE ITEMS - EDMUND SCIENTIFIC MODELS AS LISTED ABOVE OR EQUIVALENT

LUZERNE COUNTY COMMUNITY COLLEGE

LASER LABORATORY EQUIPMENT

QUAN	ITEM DESCRIPTION	BRODHEAD-GARRETT MODEL NUMBER OR EQUIVALENT	MODEL PROPOSED	UNIT PRICE	TOTAL PRICE
12	Non-skid flexible stainless steel rulers (12" long)	246528			
6	Meter stick	328317			
12	Semi-circular protractor	132091			
6	30°/60° 12" triangles	Model S-390 131848			
6	45°/90° 10" triangles	Model S-450 131881			
6	Pencil compass	Model 842 237367			
1 package	8½" x 11" Translucent tracing paper (500 sheets/package)	224307			

LUZERNE COUNTY COMMUNITY COLLEGE

LASER LAB EQUIPMENT

QUAN	ITEM DESCRIPTION	EALING MODEL NUMBER OR EQUIVALENT	MODEL PROPOSED	UNIT PRICE	TOTAL PRICE
5	Lens holders, 50 mm sliding grip lens holder	228106			
6	Rotary tables, graduated in degrees	227918			
10	Mirror mounts with X-Y adjusting screws	356436			
2	Optical flat - $\lambda/10$ flatness, 127 mm diameter	358846			
5	Filter mount; holds 50.8 x 50.8 mm filters upto 6 mm total thickness	22-8650			
2	Reticle; glass 1 cm in 0.1 mm divisions	11-8505			
4	Twin-lamp light source (has a 4v low pressure mercury vapor lamp and a 6v, 0.3A incandescent lamp)	25-8723			
4	Power supply for twin-lamp light source, 115/230v. Has separate controls for mercury and white light sources	25-9036			
2	Kodak Wratten Gel neutral-density filters (set consisting of 13 filters with neutral density 0.1 to 4.0)	35-1676			
2	Standard bandpass filters for HeNe lasers, center 632.8 nm (λ), filter size 25.4 mm	35-3904			

1	Student measuring microscope, 100 mm total travel, 100 mm calibrated scale reads to 0.1 mm, usable in six positions	11-2771
1	Spectral Lamphouse (emits light through a 19 mm diameter aperture centered on the bright portion of the spectral lamp arc which is 6.6" above the base)	27-1254
1	Spectral lamp power supply (a current selector switch provides ten, almost equal, steps from 0.7 to 1.6 amperes)	26-2683
1	Sodium spectral lamp, operating current 0.9A, power 14 W, arc length 19 mm	26-2808
2	Quarter-wave retarders for 632.8 nm wavelength, 25.4 mm diameter, 14.55 mm clear aperture, 8 mm thickness	34-5835
1	Microscopic objective, 10 x, achromatic, dry, 14.6 mm effective focal length	24-9730
1	Microscopic objective, 20 x, achromatic, dry, 8.4 mm effective focal length	24-9797
5	Utility pinhole set (a set of twenty utility pinholes), each hole is centered in a 3 mm disc of unmounted nickel shim stock 40 microns thick	22-6506
5	Standard bandpass filter for 532.0 nm wavelength, filter size 50.8 mm x 50.8 mm	35-3631

5	Standard bandpass filter for 1060 nm wavelength, filter size 25.4 mm	35-4928
20	Broad spectrum goggles for protection against Neodymium, Gallium, Arsenide, Ruby and ultra violet lasers	25-5570
5	Utility Iris diaphragms, made of blued spring steel, maximum aperture 8 mm and minimum aperture 1 mm, outside diameter 16 mm	22-3875
1	Universal interferometer which includes Universal interfermoter base, Michelson optics, Fabry-Perot optics, and Twyman-Green optics	25-9093

ALL THE ITEMS EALING ELECTRO-OPTICS MODELS AS LISTED ABOVE OR EQUIVALENT

LUZERNE COUNTY COMMUNITY COLLEGE

LASER LAB EQUIPMENT

QUAN	ITEM DESCRIPTION	NEWPORT CORPORATION MODEL NUMBER OR EQUIVALENT	MODEL PROPOSED	UNIT PRICE	TOTAL PRICE
5	Beam steering device having exit aperture height 2.5 - 9.75", entrance-exit beam spacing 1.25 - ".25", angular range 8° both axes, mirror reflectivety ≥ 93% each, and angular sensitivity 5 arc-second	BSD-1			
5	Plate glass holder, holds objects up to 7.75 inches tall at any height from 0.4 to 3.2"	PH-1			
5	Stainless steel film plate holder, holds two 4" x 5" film plates up to 0.25" thick	540			
5	Base plate	BP-3			
5	Support post, 8" in length, stainless steel, precision ground 0.5" post	SP-8			
5	Post clamp, holds two posts at an arbitrary angle with respect to each other.	CA-2			

ALL THE ITEMS NEWPORT CORPORATION MODELS AS LISTED ABOVE OR EQUIVALENT

LUZERNE COUNTY COMMUNITY COLLEGE

LASER LAB EQUIPMENT

QUAN	ITEM DESCRIPTION	MODEL PROPOSED	UNIT PRICE	TOTAL PRICE
5 sets	Six each blue, green, red gelatin or plastic color filters, 2"x 2"			
5	Beam blocks, 8" high, 2" x 4" wooden board with base, painted black			
12	Bottles with medicine droppers, 30-ml capacity			
6	Glass block, 4" cube			
5	Alignment table with 3 adjusting screws, 2" x 8" out approximately 18" long. Drill and tap holes; 2 in front corners, 1 in center back, x-tra fine thread 1/2" x 28" threads per inch, 3" long or fine, 1/2" x 20" threads per inch, 3" long			
5	Laser tube holders, vee support			
500 grams	Methanol			
50	33 Kohms, 2 Watt resistors			
5	Brewster window Helium Neon laser tubes, output power 1.4 mW, wavelength 633 nm TEM_{oo} mode, minimum polarization ratio 500:1			

142

SPECIAL CONSIDERATIONS FOR LASER LAB - ADVANCED TECH BUILDING

A. Space and Construction

1. The total space which is currently allotted for the lab should be adequate (lab - 2,595 sq. ft., storage - 375 sq. ft). No further space requirements are anticipated.

2. However, in view of the contemplated high-energy laser, a separate room within this area should be provided to house it. The room should be approximately square in shape and have at least 300 sq. ft. of floor area. The offset area in the presently planned lab space should lend itself nicely for this purpose (see attached diagram). Walls for this room need not be constructed of any special material (cinder block was recommended), but should be windowless and surfaced on the inside with a non-reflective, non-flammable material.

3. It is estimated that the outer, main lab will have space for about four work areas. Each of these work areas should have sufficient floor strength to support a four by eight foot (4' x 8') optical bench weighing in excess of one ton and having pneumatically-damped legs. These tables should be placed around the inner perimeter of the main lab area, with enough space provided for curtain-type laser barriers to be installed around them. An additional optical bench will be necessary for the inner, high-energy room (see diagram).

B. Power

Power requirement for the inner (high-energy) laser room is 220 volt, 3 phase, 20 amp., along with conventional 120 volt, 20 amp. outlets. Power for the remainder of the laser lab area can be provided by conventional 120 volt, 20 amp. outlets.

C. Water

Conventional water supply lines are acceptable, but water should be provided at all work stations.

D. Air

Compressed air (100 p.s.i.) should be provided at all work stations to service the pneumatic damping legs of optical benches.

E. Safety

1. The entrance door to the high-energy room should be fitted with a non-defeatable interlock system which will cut power to the laser upon opening the door.

   A similar interlock system should be provided for the entrance door to the main laser lab which will cut power to any class III lasers that may be operating within.

2. All work areas should be fitted with panic buttons inside <u>and</u> outside the barriers, with key-operated reset for all buttons.

3. While it is not anticipated that the vaporization of materials induced by normal laser activity will generate toxic fumes to any great extent, it is recommended that normal exhaust venting be provided in all areas should this problem develop.

F. Equipment

With the exception of the high-energy laser, all other lasers and ancillary test equipment are not expected to pose any special problems involving lab construction. Most of these devices are extremely light, portable pieces of equipment with modest power requirements which generate a safety concern only when they are improperly handled while in use.

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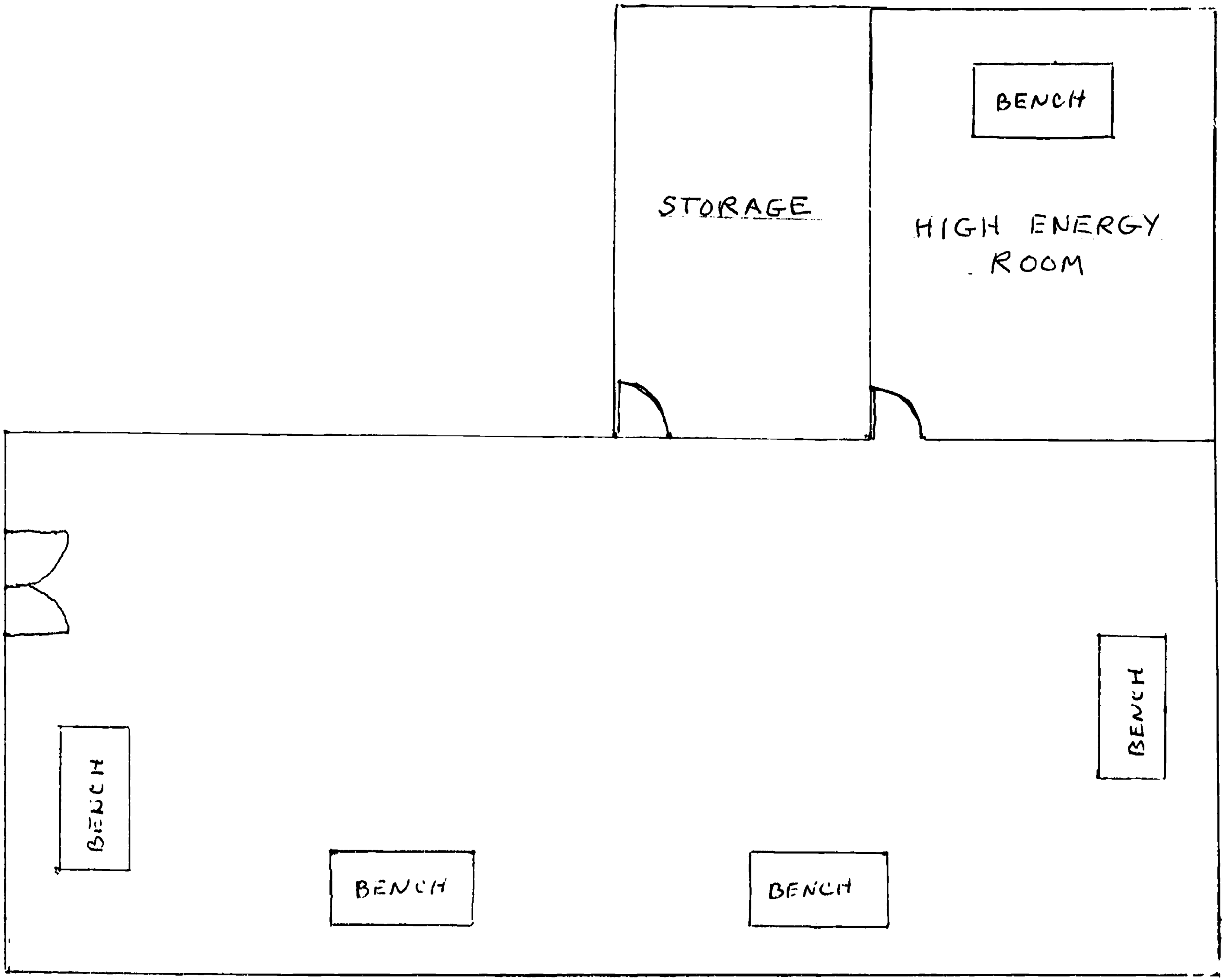

LASER LAB

SCALE: 1/8" = 1'

USE OF THE LASER LAB FOR TECHNICAL PHYSICS

It may be feasible to use a laser laboratory for courses in Technical Physics. In addition to the optics equipment already in place, the following items are also part of a laser lab and would not have to be ordered separately:

- oscilloscopes
- clip leads
- resistors(33 K ohms, 2 watt)
- power supply Balmer tube
- timers
- compass
- pressure gauge/manometer
- AC wattmeter
- DC milliammeter
- digital voltmeter
- DC power supply(5 volt DC)
- 115 Volt power supply
- function generators

However, while such multi-purpose use is feasible from a facilities point-of-view, it might not be cost effective unless there are no other alternatives, because there is still approximately $68,000 in additional equipment and supplies that would have to be purchased to offer technical physics courses. That cost is arrived at by calculating the minimum required for a class of 24 students.

Another point to consider is the amount of space available for storing the additional equipment and supplies--at least 300 square feet would be needed, with appropriate shelving and cabinets.

A final point is the use of optical tables for experiments in mechanics and thermodynamics. Precautions will have to be taken to insure that the additional hookups required will not damage the vibration free characteristics of the laser/optics tables. An alternative would be to use separate benches, which might not be feasible, if space permits.

A final recommendation would be to use the laser lab just for the optics portion of the technical physics courses, and use other labs for the remaining experiments.