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ABSTRACT

The purpose of the Photoinstrumentation Technology Program is to train technicians in creative design and implementation of high-speed and other scientific photographic recordings. The curriculum was designed to provide technicians without the A.S. degree with the opportunity to acquire the educational background necessary for salary advance and the assignement of higher level work. The curriculum is also designed to meet the specifications of the Engineer's Council for Professional Development and is geared toward individualized instruction. It is an engineering technology curriculum in the sense that it initiates specialized technical courses early in the program. The program report deals with mathematics and physical sciences, nontechnical courses, technical skills, technical specialties, laboratories, and library. It surveys existing curricula, and explains the curriculum design and how the courses will be presented. There are four appendixes: background of photoinstrumentation technology curriculum, survey of instruments used by photoinstrumentation technicians, major instructional objectives of the curriculum, and laboratory report form. Four tables in the text list a curriculum summary in terms of semester credits, the photoinstrumentation curriculum at Milwaukee Area Technical College, a survey of instruments with 50 percent or higher frequency of use, and photoinstrumentation technology courses. (JR)

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Photoinstrumentation Technology, A Two-Year Program

O. G. Bates

Sandia Laboratories

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PHOTOINSTRUMENTATION TECHNOLOGY, A TWO-YEAR PROGRAM

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Printed January 1974

ABSTRACT

The Photoinstrumentation Technology Program trains technicians in creative design and implementation of high-speed and other scientific photographic recordings.

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PHOTOINSTRUMENTATION TECHNOLOGY, A TWO-YEAR PROGRAM

Purpose

The purpose of the Photoinstrumentation Technology Program is to train technicians in creative design and implementation of high-speed and other scientific photographic recordings. The technician must be able not only to accept general directions to record but to (1) determine what is to be recorded and (2) select and assemble the system that best achieves the desired information record. Specific instructional objectives are included in the report.

Background

The development of this program of study is the result of a letter (Appendix A) from the Sandia Photometrics Division requesting that a two-year, photoinstrumentation technology curriculum be developed. A principal concern is that technicians without the A. S. degree are potentially handicapped in the salary merit review system and in the assignment of higher level work because of the lack of educational opportunity. The development of this curriculum, then, will provide the opportunity for all employees to acquire a similar educational background; thus, theoretically, all should have an equal-knowledge basis on which to compete for the higher level work.

Design Criteria

The essential design criteria are as follows:

- The curriculum shall meet the course specifications set forth by the Engineer's Council for Professional Development (ECPD).
- The courses shall incorporate Sandia applications in support of the theoretical topics; thus, the training is highly job related.
- The courses shall be individualized to the extent that only three or four students can meaningfully participate.
- Content in the technical specialty courses shall be approved by the requesting supervisor, R. K. Petersen.

ECPD Accreditation

To clarify some of the major points included in the ECPD accreditation as required by the Design Criteria, the following information is given.[1]

Definitions

Engineering technology is that part of the engineering field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational area between the craftsman and the engineer at the end of the area closest to the engineer.

Engineering technology is concerned primarily with the application of established scientific and engineering knowledge and methods. Normally, engineering technology is not concerned with the development of new principles and methods. Technical skills such as drafting are characteristic of engineering technology.

Engineering Technology Curriculum

An engineering technology curriculum differs significantly from a pre-engineering curriculum, which is equivalent to the first two years of an engineering program. The technology curriculum must initiate specialized technical courses early in the program. Table I summarizes the minimum semester-hour recommendations, along with an illustration of their possible application to a 72-hour curriculum. The 72-hour program is an example only; many variations are possible.

TABLE I

Curriculum Summary in Semester Credits

	Minimum*		Example	
Basic Science Courses				
Mathematics (e.g., algebra, trigonometry, calculus)	9		12	
Physical Sciences (e.g., physics, chemistry)	6	15	6	18
Nontechnical Courses				
Communications (e.g., English composition, speech, report writing)	6		6	
Humanistic-Social Studies (e.g., economics, literature, history)	6		6	
Other (e.g., management, human relations, or additional humanistic-social studies)	3	15	3	15
Technical Courses				
Technical Skills (e.g., basic drafting, manufacturing processes)	6		6	
Technical Specialties (e.g., semiconductors, strength of materials)	24	30	33	39
		60		72

*Institutions should view with concern any curriculum which meets only the minimum shown above. Variations above the minimum are not only expected but desirable.

[1]This information was taken from Engineering Technology Education Study Final Report of the American Society of Engineering Education, January 1972.

Mathematics and Physical Sciences

All branches of engineering technology are built upon a foundation of mathematics and physical science. Mathematics is one of the more critical determinants of both the level and the quality of an engineering technology curriculum. The most common criticism by graduates and employers is directed toward the level of mathematical content of engineering technology programs. There is no doubt that the extent to which the physical science and technical specialties portions of the curriculum can be pursued will be determined greatly by the mathematical preparation of the student.

Recommendations:

1. Mathematics taught in the engineering technology curriculum should be college level and emphasize problem solving rather than extensive mathematical proofs.

2. Mathematics should generally be taught, in courses separate from science and technical subjects, by qualified mathematics instructors familiar with the engineering technology objective.

3. Enough calculus should be taught to guarantee that students are professionally literate in the subject and to permit use of this mathematical tool in the technical specialties.

The mathematical sciences underlie all the technical courses in the curriculum; similarly, the physical sciences give them unity. Thus, it is to the physical sciences that the engineering technician must look for the fundamental concepts which tie together all the technical areas. Toward this end the courses should emphasize the understanding, measurement, and quantitative expression of the phenomena involved. Physical science courses should be accompanied by appropriate laboratories. Careful work, precise observation, and accurate measurement and recording should be emphasized.

Nontechnical Courses

An engineering technician's education should include instruction in linguistic communication, humanist social studies, and other appropriate nontechnical studies. Technicians have expressed the need for better preparation in English and report writing. Engineering technology curricula must educate students not only for immediate employment after graduation but also for subsequent development as citizens and responsible human beings and should whet interest in personal development in these areas after graduation.

Technical Skills

The ASEE Report on the Evaluation of Engineering Education (1955) indicated that future engineering curricula would probably show a decrease in the proportion of time devoted to such technical skills as drafting and manufacturing processes. The engineering technician has been expected to move upward to fill this gap. Graphic expression is as much a part of technical language as is mathematics. Every engineering technician should have a firsthand knowledge of the general capabilities, limitations, and economics of the conventional manufacturing or construction techniques used in the phase of industry in which he works.

Technical Specialties

The technical specialties, or majors, cover such areas as electrical, electronic, mechanical, civil, chemical, and construction technology. The technical specialties are always in transition. What is, today, an innovation in professional engineering becomes, tomorrow, the established engineering practice falling within the province of the engineering technician. Technical specialties courses should include considerable attention to problem identification and solution and should also emphasize the quantitative analytical approach. Provision should be made for a design project or course in which the student is required to integrate the knowledge obtained throughout the program.

Laboratories and Library

Theory courses in the technical specialties should be accompanied by coordinating laboratory experience which stresses measuring physical phenomena and collection, analysis, interpretation and presentation of data. Students should be reasonably familiar with the types of apparatus that they may encounter in industry.

Use of the library is essential in all forms of higher education. The library supporting an engineering technology program should be one which will encourage the student to develop the habit of consulting the technical press and professional journals in his field. The library should also support the nontechnical portion of the curriculum.

Existing Curricula

Before the photoinstrumentation curriculum was designed, a search was made to determine "who teaches what." Unfortunately, the results showed that "not many people teach anything."

Only one college was found to teach photoinstrumentation: Milwaukee Area Technical College (MATC). There are, however, several colleges that teach closely allied optics subjects; for example, laser and photographic technologies. For the search, the following sources were consulted:

- The College Blue Book
- ERIC (Educational Resources Information Center)
- Dr. M. W. Roney, Executive Vice-President, Texas State Technical Schools, Waco, Texas
- Commander Fred Shaw, Aerospace Recovery Facility, U. S. Navy (USN), El Centro, California

- Captain Dennis Irion, LNC, Randolph AFB, San Antonio, Texas, U. S. Air Force (USAF)
- Milwaukee Area Technical College

According to Commander Shaw, the USN does train photoinstrumentation technicians but not in the formal sense (with classroom, teachers, textbooks, and homework assignments). Commander Shaw uses the one-on-one, individualized tutorial approach, which has apparently worked quite well.

The USAF trains what it calls optics technicians (OT). The OT group is subdivided into maintenance and operation. SLA, of course, is not interested in maintenance per se but in the operation. A correspondence with Captain Irion is being continued to determine whether some of the USAF "software" would be applicable to our objectives. The curriculum as a whole would not be.

The MATC curriculum provided the most useful information with regard to designing the technical specialty courses.

1. Sandia has hired two MATC graduates and both seem well qualified for SLA-type work.
2. The topics have an obvious correlation with SLA work.

Table II is a breakdown of the photoinstrumentation course taught at MATC.

TABLE II

Photoinstrumentation Technology - MATC

			Credits	
		First Year	**1st Semester**	**2nd Semester**
Photo	101	Fundamental Photography	3	
Photo	139	Measurement Techniques	3	
Elec T	112	D. C. and A. C. Fundamentals	4	
Eng	151	Communication Skills 1	3	
Math	151	Technical Mathematics 1	4	
Phy Ed	101	Physical Education	1	
Soc Sci	100	Orientation	0	
Photo	108	Photographic Lighting		3
Photo	180	Industrial Photography		3
Elec T	114	Basic Electronic Circuits		4
Eng	152	Communication Skills 2		3
Math	152	Technical Mathematics 2		4
			18	17
		Second Year		
PhoIn T	104	Flash Tube Circuits	4	
PhoIn T	110	High-Speed Photography	3	
Photo	161	Introduction to Optics	3	
Nat Sci	151	Technical Physics 1	4	
Soc Sci	153	American Institutions	3	
PhoIn T	108	Photoinstrumentation Systems		4
PhoIn T	112	Control Equipment		4
Photo	186	Cinematography		3
Soc Sci	151	Psychology of Human Relations		3
Soc Sci	155	Business and Industrial Relations		3
			17	17

SLA Curriculum Design

The mathematics, science, and nontechnical courses were chosen to conform to the ECPD specification as outlined above. The technical specialty courses, however, were more difficult to identify and specify. Two approaches were taken to achieve specificity. First, an equipment survey was conducted to identify all of the significant instruments used by SLA's photoinstrumentation technicians. Second, major instructional objectives, based on the knowledge of existing job descriptions, were specified. The integration of data from these two sources will provide the bases for decisions on the content and instructional strategies for each of the specialty courses.

The equipment survey includes an estimate of both the time required to learn to operate and the frequency of use. The full survey is given in Appendix B. Table III gives the instruments identified with a frequency of use equal to or greater than 50 percent, along with the estimate of "time to learn." Although many of the instruments were listed as low frequency (0-25%), this rating does not imply "not important." Many of the instruments are of critical importance to certain types of experiments and this fact will be considered in teaching the courses.

TABLE III

Survey of Instruments With 50 Percent or Higher Frequency of Use

Instruments	Estimate of Hours Required To Learn To Operate		
Cameras	0-8	9-16	> 16
RI MC-201			X
Milliken			X
Darkroom Equipment			X
Oscilloscopes			X
Digital Counters	X		
Programmers	X		
Lighting Systems			
Strobes		X	
Spark Sources		X	
Flash Systems	X		
Delay Generators		X	
Timing Generators	X		
Power Supplies		X	
Isolation Systems		X	
Light Meters		X	

The major instructional objectives are not complete descriptions of what the student will be able to do after instruction but, rather, the most important areas to teach. Each of these major instructional objectives will have many subordinate objectives (teaching points).

The major objectives for all the courses in the curriculum are given in Appendix C. The SLA curriculum without objectives is given in Table IV.

TABLE IV

Photoinstrumentation Technology Courses

Course Number	Semester Credit Hours	Course Title
Mathematics		
AU7735A	4	Tech Math I, Algebra
AU7736 / AU7726	4	Tech Math II, Algebra and Trig
MA836Y	3	Tech Math III, Calculus
Physics		
PH802Y	3	Elements of Physics I
PH803Y	3	Elements of Physics II
Communications		
LA100A	4	Technical English
LA101A	4	Technical Report Writing
Electronics		
BH104	3	Introduction to Electricity and Electronics
BH125	3	Active and Passive Components
BH242	3	AC Effects and Basic Amplifier Circuits
BH252	3	Basic Electronic Circuit Applications
BH256	3	Electronic Circuits and Systems: Electronic Applications
BH501	3	Pulse and Digital Circuits
Technical Specialties		
GA109A		Basic Photography
GA110A		Photographic (· ics
GA111A		Photographic Lighting
GA112A		Industrial Photography
GA113A		Cinematography
GA114A		Sensitometry
GA200A		High-Speed Photography
GA201A		Photographic Instrumentation
GA203A		Laser Laboratory
GA204A		Photoelectric Imaging Devices

Credit hours have not been determined.

How the Courses Will Be Presented

All of the courses are available "in-house"; however, to individualize to the extent that three or four students can participate, three different approaches will be used to teach the courses. First, the Out-of-Hours Program will be used to teach Technical English and Technical Report Writing (Table IV). These courses are available during the noon hour and/or in the evening immediately after work. Second, the Self-Study Program will be used to teach mathematics, physics, and electronics (Table IV). A departure from the normal administration of these courses will be made, however, in the following ways:

- An instructor/proctor will be assigned to work with the student on a one-to-one tutorial basis
- Specific instructional objectives will be taught and achievement of these objectives assessed
- The electronics courses will be strongly supported by laboratory activities

Third, instruction of the technical specialty courses will include use of the resources of the Photometrics Division, 9412, in an informal format. Again, instructional objectives will be specified and achievement of these objectives measured. In the advanced courses, problems/projects will be assigned and written reports will be required. To assist the student/instructor and assure good communication as to what is required, a lab report form (Appendix D) has been prepared. Mr. Petersen will work with the training representative and instructor in specifying and measuring the achievement of the subordinate objectives (teaching points).

APPENDIX A

BACKGROUND OF PHOTOINSTRUMENTATION
TECHNOLOGY CURRICULUM

Sandia Laboratories

date: July 9, 1973

to: H. M. Willis - 3130

from: R. L. Brin - 9310

: TI (AAS Degree) Equivalency for Photo-Instrumentation

One of the problems encountered by the Photometric Division 9312 has been that until the recent past TI Certificates in Electro Photo-Optical technology have not been granted. As a result only two of the fourteen technical photographers in the division have AAS Degrees. These are, of course, the two most recently placed on roll from Milwaukee Institute. The only available programs at Sandia for achieving TI equivalency have been in fields not directly related to Electro Photo-Optics.

For these reasons would your organization explore the feasibility of establishing a program to fill this technological need, preferably one that could be individualized for a limited number of people. O. G. Bates, Organization 3132 and R. K. Petersen, Organization 9312 have had some preliminary discussions relating to this problem.

RKP:edd

Copy to:
R. K. Petersen, 9312
R. L. Brin, 9310

APPENDIX B

SURVEY OF INSTRUMENTS USED
BY PHOTOINSTRUMENTATION TECHNICIANS

Survey of Instruments Used
by Photoinstrumentation Technicians

Instruments	Estimate of Hours Required To Learn To Operate			Frequency of Use As a Percentage of Total Experiments			
	0-8	9-16	Over 16	0-25	26-50	51-75	76-100
CAMERAS							
CORDIN 330			X	X			
CORDIN 114			X	X			
CORDIN 119			X	X			
RCMC-201			X		X		
FASTAX		X		X			
DYNAFAX		X		X			
MILLIKEN	X				X		
HYTAX	X			X			
IMC			X	X			
HYCAM		X		X			
LOCAM		X		X			
FAIRCHILD	X			X			
NOVA	X			X			
HULTCHER	X			X			
TRW		X		X			
PHOTOSONICS CFA	X			X			
PHOTOSONICS 1-P		X		X			
PHOTOSONICS 1-B	X			X			
PHOTOSONICS 1-F	X			X			
PHOTOSONICS 1-E	X			X			
PHOTOSONICS 1-C	X			X			
PHOTOSONICS 4-C		X		X			
PHOTOSONICS 4-E		X		X			
PHOTOSONICS 10-A		X		X			
PHOTOSONICS 10-B		X		X			
MITCHELLS		X		X			
AUTOMAX 35	X			X			
SCOOPIC	X			X			
BELL & HOWELL	X			X			
4X5 VIEW		X		X			
35 MM MINIATURE			X	X			
2-1/4 x 2-1/4	X			X			

Instruments	Estimate of Hours Required To Learn To Operate			Frequency of Use As a Percentage of Total Experiments			
	0-8	9-16	Over 16	0-25	26-50	51-75	76-100
PHOTOENLARGERS		X		X			
DARKROOM EQUIPMENT			X		X		
ASTRONOMICAL TELESCOPE		X		X			
OPTICAL INSTRUMENTS			X	X			
MIRRORS FOR:							
SHADOWGRAPHY							
SCHLIEREN			X				
INTERFEROMETRY							
OSCILLOSCOPES			X	*	X		
OPTICAL BENCH			X	X			
DENSITOMETERS	X			X			
MICRODENSITOMETERS			X	X			
SENSITOMETERS		X		X			
TRANSITS			X	X			
PRECISION LEVELS	X			X			
PAPER RECORDERS	X			X			
DIGITAL COUNTERS	X			X	X		
TRACKING MOUNTS			X	X			
PROGRAMMERS	X						X
LASERS			X	X			
LIGHTING SYSTEMS							
STROBES		X				X	
SPARK SOURCES		X			X		
FLASH SYSTEMS	X				X		
LIGHT METERS		X			X		
LIGHT SENSORS		X		X			
FIRE SETS	X			X			
DELAY GENERATORS		X			X		
TIMING GENERATORS	X				X		
POWER SUPPLIES		X			X		
ISOLATION SYSTEMS		X				X	

* Occasional

APPENDIX C

MAJOR INSTRUCTIONAL OBJECTIVES FOR THE PHOTOINSTRUMENTATION TECHNOLOGY CURRICULUM

MATHEMATICS

Tech Math I and II, Algebra and Trig

After instruction the student will be able to

- define sets, relations, and variables.
- express quantities in equations, inequalities, and open sentences.
- perform mathematical operations in set N.
- perform mathematical operations in set R.
- perform mathematical operations using polynomials.
- perform systematic solutions of equations and inequalities of first- and second-degree polynomials (including the quadratic formula).
- solve verbal problems.
- solve rational equations.
- perform mathematical operations using complex numbers.
- graph equations in two variables including conic sections.
- use remainder and factor theorem to find roots of higher degree polynomial equations.
- define the basic trig functions.
- solve problems using the law of sines and the law of cosines.
- convert between degrees and radians.
- solve problems using inverse, complementary, and reciprocal functions.
- interpolate from trig tables.

Tech Math III, Calculus

After instruction, the student will be able to

- compute the limits of functions.
- obtain velocities from functions by differentiation.
- graph a function and its derivative.
- determine minimum and maximum of functions.
- differentiate simple trigonometrics and logarithmic and exponential functions.
- graphically represent the forces of integration.
- compile areas under curves using integration techniques.
- perform simple, double, and triple integration and give physical interpretation of these processes.

PHYSICS

Elements of Physics I

After instruction the student will be able to

- measure in various systems time, distance, mass.
- perform arithmetic operations using scientific notations.
- add, multiply, subtract, and divide force vectors using graphic and algebraic techniques.
- graphically represent motion.
- define and solve problems involving acceleration.
- explain and give physical examples of Newton's three laws of motion.
- relate mass and weight with regard to gravity.
- solve problems involving circular motion, equilibrium, impulse, and momentum.
- differentiate work, energy, and power.
- solve elementary problems in thermodynamics.
- define Boyles law, Charles law, and absolute zero.

Elements of Physics II

After instruction the student will be able to

- describe waves and the nature of their behavior, including frequency period and wavelength.
- explain the phenomena of sound using wave theory.
- define polarization, frequency spectrum, and reflections of light.
- explain plane mirror images.
- solve problems using Snell's law and the index of refractions.
- graphically analyze lens and image.
- explain formation.
- describe interference phenomena, including phase relations, diffraction, and Young's experiment.
- solve physical optics problems involving luminous intensity, inverse square law, electromagnetic spectrum, and lumens.

COMMUNICATIONS

Technical English (LA100A)

After instruction the student will be able to

- identify basic parts of a sentence.
- describe the functional relationships of the sentence parts.
- analyze "muddled" sentences and paragraphs and rewrite to improve the communication of the ideas.

Technical Report Writing (LA101A)

After instruction the student will be able to

- write technical reports in the Sandia format, using good, clear writing techniques learned in LA100A.

ELECTRONICS

Introduction to Electricity and Electronics (BH104)

After instruction the student will be able to

- define a conductor.
- describe current flow.
- compute voltage drops in a series circuit.
- compute equivalent resistance for complex series or parallel resistor networks.
- be able to use VOM correctly for current, voltage, and resistance measurement.

Active and Passive Components (BH125)

After instruction the student will be able to describe the operating characteristics of the following:

- vacuum diodes.
- semiconductor diodes.
- capacitors.
- inductors.
- transformers.
- PNP and NPN transistors.

AC Effects and Basic Amplifier Circuits (BH242)

After instruction the student will be able to

- design a simple VOM.
- compute the impedance of a series or parallel RLC circuit.
- describe the relationship between bandwidth and Q in a circuit.
- compute time constants for RC and RL circuits.
- describe the operation of a class A, B, or C amplifier.
- describe the phase relationship between voltage and current in an RC, RL, or RLC series or parallel circuit.
- define impedance, reactance, and resonance.
- compute power in an AC circuit and describe power transfer.
- define and compute wavelength.

Basic Electronic Circuit Applications (BH252)

After instruction the student will be able to

- describe frequency modulation in a TV broadcast system.
- analyze r-f amplifier circuits.
- compute amplifier efficiency.
- tune an r-f amplifier.
- describe and justify neutralization.
- describe the operation of the following oscillator circuits: tuned-grid, tuned-plate, shunt-fed Hartley; series-fed Hartley; and shunt-fed Colpitts.
- explain the operation of SCR's, FET's, and JFET's.
- analyze regulating characteristics of circuits using zener diode regulators.
- explain the operation and use of unijunctions.

Electronic Circuits and Systems: Electronic Applications (BH256)

After instruction the student will be able to

- explain and troubleshoot the operation of basic power supply circuits.
- operate the oscilloscope to measure time relationships, voltage, and current.
- explain the operation of DC and AC motors and generators.
- analyze and troubleshoot the following types of circuits:
  - high-voltage power supplies
  - magnetic amplifiers
  - simple communication systems using photoelectric devices

Pulse and Digital Circuits (BH501)

After instruction the student will be able to

- analyze waveshaping circuits involving resistor, battery and diode.
- identify high- and low-pass RC circuits.
- explain integrating and differentiating circuits using appropriate R, L, and C components.
- explain the detailed operation of a flip-flop circuit using transistors.
- analyze simple transistor oscillator circuits.
- analyze a multistage amplifier with regard to bandwidth.
- explain how gating circuits function.
- analyze the following types of circuits: TTL, DTL, and RTL.

TECHNICAL SPECIALTIES

Basic Photography (GA109A)

After instruction the student will be able to

- compose and photograph subjects with the various types of equipment in use today, excluding those of a high-speed nature.
- select the proper films.
- determine exposure times.
- use light meters
- set up basic lighting equipment.
- practice appropriate darkroom procedures to develop and print most types of black and white films.

Photographic Optics (GA110A)

After instruction the student will be able to

- select the proper lens system to obtain the photographic results required.
- determine image sizes and resolution requirements.
- compensate for optical characteristics such as vignetting, field flatness, and circle of confusion.

Photographic Lighting (GA111A)

After instruction the student will be able to

- analyze an existing situation and determine the proper lighting techniques to record the scene on photographic materials.
- apply the principles involved in the basic nature of light, including color temperature, spectral distribution, and light sources.

Industrial Photography (GA112A)

After instruction the student will be able to

- carry through an assignment to record an industrial situation on film in such a way as to convey the situation to the viewer (e.g., safety hazard, equipment setup).

Cinematography (GA113A)

After instruction the student will be able to

- operate the various documentary cameras in order to record a situation involving subject motion.
- record the subject in such a manner as to present a pleasing, as well as informative, movie.

Sensitometry (GA114A)

After instruction the student will be able to

- operate sensitometers, densitometers, and microdensitometers in order to determine film responses to radiation.

High-Speed Photography (GA200A)

After instruction the student will be able to

- operate the various high-speed and ultra-high-speed cameras, associated controls, and other equipment in such a manner as to record short-duration phenomena for data-recording purposes.

Photographic Instrumentation (GA201A)

After instruction the student will be able to

- accept an assignment, determine what is to be recorded, and select and assemble the best system to achieve the desired information record.
- determine inadequacies in existing equipment and define new requirements.

Laser Laboratory (GA203A)

After instruction the student will be able to

- make holograms and interferograms.

Photoelectric Imaging Devices (GA204A)

After instruction the student will be able to

- operate video equipment, image intensifiers, and image-converter cameras.

APPENDIX D

LAB REPORT FORM

Instructor ______________________ Student ______________________

Sec. No. ______________________

LAB REPORT

SANDIA LABORATORIES

Project No. ____________ Course No. ____________ Date ____________

PURPOSE(S) OF THIS PROJECT

EQUIPMENT AND SUPPLIES USED

DESIRED RESULTS

SA 4030 G (10 73)

PROCEDURES

EXPLANATION OF ABOVE CIRCUIT

DRAWING AND DIMENSIONS OF SETUP

RESULTS OF EACH TRIAL

(Table of Data)

COMPUTATIONS

POSSIBILITY OF ERRORS IN DATA OBTAINED

COMMENTS ON DIFFICULTIES ENCOUNTERED IN THIS PROJECT

KNOWLEDGE OR SKILLS GAINED FROM THIS PROJECT

DISTRIBUTION:
C. D. Broyles, 1100
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R. C. Colgan, 3153
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