A REPORT AND RECOMMENDATIONS ON PHYSICS INSTRUCTION

COLLEGE OF AGRICULTURE, SEOUL NATIONAL UNIVERSITY

SEOUL, KOREA

by

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PREFACE

This report covering the present status of the physics instruction at the College of Agriculture, Seoul National University together with suggestions and recommendations for its improvement, represents part of the work done in Korea during the period August 9 to December 19, 1956 as Adviser in Agriculture, Seoul National University Cooperative Project.

The purpose of my mission was (1) to assist in the preparation of new course outlines for the physics courses offered to students in the College of Agriculture, Seoul National University, (2) to assist in setting up new equipment for lecture demonstrations, and (3) to give instructions in the proper use of this equipment as recommended in the report by Professors C. H. Bailey and P. W. Manson, December 1,1955, page 25.

In addition to the work represented by this report, two other important activities were carried on: (1) assistance was given to the College of Engineering in their physics laboratory work (a copy of the report submitted to Dean Yung Mo Hwang on November 13, 1956 is attached) and (2) considerable time was spent in working directly with Professor Yung Kwan Pak, Physics Lecturer, in illustrating the proper methods and techniques in the use of physics lecture demonstration equipment. This necessary and very important task was greatly handicapped and could not be completed because needed demonstration apparatus was not delivered in time.

In carrying out my work, Dean Baik Hyun Cho and his whole staff gave me their whole-hearted and unsparing cooperation. Their sincere and cordial reception made my task easier and my stay most pleasant. Special thanks are due Mr. Young Kwan Pak, physics instructor, for supplying all the necessary information with respect to the present physics courses and in

giving suggestions with respect to proposed changes in these courses which might be influenced by specific Korean conditions and Professor Chang Ku Rhee, head of the Agricultural Engineering Department for his continual interest and cooperation.

It is with special gratitude that I acknowledge the encouragement, advice and counsel which I received from Dr. A. E. Schneider, Chief Adviser, Seoul National University Cooperative Project. His understanding and help increased my contribution to the project.

INTRODUCTION

This report will be concerned with the improvement of the physics instruction offered to the students in the College of Agriculture, Seoul National University. Presently all first year students in the College are required to take one year of physics - General Physics, En 101 and En 102. The Agricultural Engineering students are required to take a second year of physics - Advanced Physics, En ( ) and En ( ).

To serve as part of the background for proposed changes in the contents of the physics courses as presently offered, many of the physics lectures were visited. In addition, classes in mathematics and engineering were also visited. Professor Young Kwang Pak supplied such information as course contents, list of assigned problems, and copies of examinations for the first semester, April 3 - July 20, 1956, physics courses. The same information was obtained for the proposed work for the second semester, September 1, 1956 to Febuary 26, 1957. A tabulation of this information in given in Appendix A.

In a visit to the Kangnung Agricultural High School the physics training of the students was reviewed with Mr. Suk Joon Yu, Principal of the High School. This training consisted of one lecture hour per week for the second and third year students. No laboratory work or demonstrations were given. The time devoted to chemistry was the same as for physics. In contrast, the training in mathematics consisted of 5 hours per week for the first and second year students and 4 hours per week for the third year students. According to Dean Cho the Kangnung Agricultural High School is better than average. Thus one can conclude that the high school training in physics chemistry is rather limited and the training in mathematics more extensive. Mathematics is also one of the areas stressed in the college

entrance examinations together with Korean language and English. This training in mathematics should be exploited in the physics courses offered in the college.

In addition to considering the previous training of students, the present course content, and the need for physics training by agricultural students now and in the future, the recommendations and suggestions for improving the physics instruction are tempered by my twenty years of agricultural physics experience.

COURSE OUTLINES

As one will note by reviewing the material in Aprendix A, only mechanics, electricity, magnetism and sound are presently included in General Physics. The other areas of physics - heat, light, and modern physics - are included in the Advanced Physics. In my opinion there are 2 faults with this procedure.

1. Since General Physics is a terminal course for all the agricultural students except agricultural engineers it is desirable that they be exposed to the whole field of classical physics.

2. The term Advanced Physics is a misnomer because, as now given, the course Advanced Physics is only a continuation of General Physics. If the present scheme is to be continued a logical description of the courses would be General Physics 101, 102, 103 and 104 dropping the term, Advanced Physics.

Also as noted in Appendix A very few problems were assigned to the students. They had no text book other than a mimeographed translation into Korean of a part of the book the lecturer used for reference. In the classes which I attended the lecturer more or less read the mimeographed or his own notes rather than "lecturing" and working out examples. Students can not become proficient in physics without applying the principles in the solution of problems.

In the suggested course outlines which follow, the time devoted

to mechanics in General Physics has been drastically reduced as compared to the present (1956 - 57) course offering in order to make room for heat and light. It is believed that such a procedure will give a much better balanced and useful course for students in general agriculture. It will also be satisfactory for the students in agricultural engineering because they get additional work in mechanics in (Advanced) physics.

I. General Physics

The suggested course outlines for General physics En 101 and En 102 are given in Appendix B. These outlines are set up on the basis of 2 lectures per week and the desirability of students in Agriculture getting some subject matter from the whole field of classical physics rather than just a part of it as is the case presently. Such a course should be much more useful to students taking only one year of physics. Obviously, the sections included need to be selected with care in order to give adequate coverage and at the same time be more than a superficial discussion of a large number of topics. The topics need to form a coherent whole and serve as a good foundation in moving to more advanced work and at the same time be a challenge and a stimulus toward achievement for the students.

The course outlines are given in complete detail including suggested topics, time devoted to each, and the appropriate lecture demonstrations. At first glance the large difference in the total number of lectures planned for the 1st and 2nd semesters might seem to be an error but this is not the case. It is the result of the large difference in the length of the 2 semesters. In 1956 the 1st semester, April 3 to July 20 inclusive, had a total of 109 days and the second semester, September 1 to December 20 and February 4 to February 26 inclusive, will have a total of 134 days.

Unfortunately there is no textbook which covers the topics exactly in the order given. Most American textbooks are designed for 3 to 5 lectures per week for one year and the shorter ones are written at a lower mathematical level than in necessary for Korean college students. For this reason it seems desirable that the lecturer be given sufficient time to prepare mimeographed notes of his own, taking advantage of the mathematical training of the students.

In presenting demonstration lectures as suggested in these outlines considerable time is required to set up, disassemble, maintain add repair the equipment. This additional time requirement must be recognized by the administration by supplying a technician to assist the staff member giving demonstration lectures.

II. Advanced Physics

The suggested course outlines for Advanced Physics are given in Appendix C. These outlines include advanced material on some topics introduced and briefly discussed in General Physics and expands the coverage by including many new topics. The purpose is to utilize the training received in General Physics as a foundation for a more advanced and broader training in physics. In these courses calculus should be used at every opportunity.

It is urged that the same textbook be selected for these courses as the Engineering College uses for their courses in physics.

Since physics is so very important to the agricultural engineers, it can not be emphasized too strongly that the instructor of these courses must assign and expect the students to solve a large number of problems.

LABORATORY

Experience gives convincing evidence that the proper appreciation of the methods of science can best be developed by having laboratory work form an essential part of the course. The laboratory serves to exemplify and illuminate the physical principles studied in the classroom and gives a student a working knowledge of some of the methods and instruments which are used quite generally in many laboratories to solve problems of the most varied type, both physical and biological. It is highly questionable that a sound working knowledge of physics, or even its proper appreciation, can be gained by a student without some direct experience in the laboratory. The opportunity to use laboratory equipment and develop skill in its use is especially important for students in the College of Agriculture. Nowhere in their previous training or experience have they had any chance to develop the necessary techniques or even use very simple laboratory apparatus.

A list of appropriate laboratory experiments have been selected to complement the course outline for General Physics, En 101 and En 102. These experiments are listed below:

List of Recommended Laboratory

Experiments for

Physics - En 101 and Physics - En 102

Exp. No.	Title	References*
1	Errors in Measurements	1
2	Density of Solid	1
3	Specific Gravity	1
4	Equilibrium of Forces	1
5	Moments	3
6	Surface Tension (Hooke's law)	1
7	Friction	1, 3
8	Work, Power and Machines	1, 3
9	Simple Pendulum	1
10	Linear Expansion	3, C
11	Air Thermometer	2
12	Specific Heat	3
13	Heat of Fusion and Vaporization	3
14	Hygrometry	1
15	Magnetic Fields	2, 3
16	Joules Law	1
17	Ohm's Law - Resistance of Lamps	1
18	Resistances in Series and in Parallel	3
19	Slide Wire Wheatstone Bridge	1
20	Temperature Coefficient of Resistance	2
21	Potentiometer	1, 3
22	Thermocouple	3
23	Electromagnetic Induction	1

Exp. No.	Title	References*
24	A. C. Series Circuit	1
25	Velocity of Sound - Resonance Tube	1
26	Reflection and Refraction	1
27	Lenses	1
28	Optical Instruments	1
29	Spectrometer	W
30	Diffraction Grating	1
31	Efficiency of Encandescent Lamps	2, 3

*References are numbered or lettered as follows:

1. Physics Laboratory Manual by C. N. Wall and R. B. Lavine Prentice-Hall, Inc., New York, 1951

2. Experiments in Physics by L. R. Ingersoll and M. J. Martin McGraw-Hill Book Company, New York

3. Experimental College Physics by M. W. White McGraw-Hill Book Company, New York

C. Catalog, Central Scientific Co., Chicago, Ill.

W. Catalog, W. M. Welch Scientific Co., Chicago, Ill.

In appendix D. There is a complete listing of the apparatus needed for each experiment together with the cost as given by the latest price lists furnished by the scientific equipment supply houses. The lists are complete except for materials such as electric wire, switches, light bulbs, etc., which are available in Korea. The equipment was also selected on the basis that the only sources of electrical energy available would be 115 volts (100 volts) 60 cycles/sec. A. C. and dry cells.

The numberof individual sets of equipment for each separate experiment is based on a compromise between the ideal situation, individual performance of each experiment by each student, the economic situation, and

cost of the apparatus required. A limited budget generally precludes reaching the ideal state.

A summary of the equipment cost is given in the following table. It is important to note that the cost per set represents the additional cost to equip the laboratory for performing the particular experiment. For example, included in the cost, $56.42, for experiment 2, Density of a Solid, are a trip balance and set of weights. This same equipment will be used in experiment 3 but the cost of it is not included in the cost listed as $14.48. The cost represents the value of additional needed apparatus in each case.

The total cost represents the actual cost to obtain sufficient equipment to do all the experiments listed without any duplication of apparatus.

In the last column of the table is given the cost for obtaining enough sets to take care of one laboratory section of 20 students with all the students performing the same experiment. For most experiments it is recommended that one set of apparatus be purchased for each two students. This permits essentially individual performance of each experiment by the students.

It is recommended that any one laboratory section be limited to a maximum of 20 students in order that the teacher may give the students individual attention and assistance.

If two laboratory sections are to be in session at the same time then the equipment needed must be doubled in order for all the students to do the same experiment. The alternatives are (1) assign more students to each set of apparatus or (2) have the 2 sections perform different experiments. In the latter case some thought will need to be given to

pairing the experiments to prevent conflict in the use of certain pieces of equipment. If this latter scheme is followed it may be necessary to duplicate some pieces of apparatus.

Summary of Physics Laboratory Equipment Cost

I. Physics Laboratory, En 101, 1st Semester

Exp. No.	Title	Cost per Set	Recommended Minimum for 20 students Sets	Cost
2	Density of a Solid	$56.42	10	$564.20
3	Specific Gravity	14.48	10	144.80
4	Equilibrium of Forces	101.94	5	509.70
5	Moments	17.65	10	176.50
6	Surface Tension (Hooke's Law)	22.37	10	223.70
7	Friction	18.78	10	187.80
8	Work, Power and Machines	87.55	10	8
9	Simple Pendulum	7.75	10	7
10	Linear Expansion	20.92	10	209.
11	Air Thermometer	22.55	10	225.5
12	Specific Heat	40.77	10	407.70
13	Heat of Fusion and Vaporization	.95	10	9.50
14	Hygrometry	39.35	10	393.50
	Total	$451.48		$4005.10

II. Physics Laboratory, En 102, 2nd Semester

Exp. No.	Title	Cost per Set	Recommended Minimum for 20 students Sets	Cost
15	Magnetic Fields	$ 9.96	10	$ 99.60
16	Joules Law	95.60	10	956.00
17	Ohm's Law	26.72	10	267.20
18	Resistances in Series and in Parallel	113.10	10	1131.00
19	Slide Wire Wheatstone Bridge	109.76	10	1097.60
20	Temperature Coefficient of Resistance	15.25	10	152.50
21	Potentiometer	123.10	10	1231.00
22	Thermocouple	36.13	10	361.30
23	Electromagnetic Induction	5.11	20	102.20
24	A. C. Series Circuit	106.00	5	530.00
25	Velocity of Sound	48.40	5	242.00
26	Reflection and Refraction	6.81	20	136.20
27	Lenses	54.70	10	547.00
28	Optical Instruments	9.42	10	94.20
29	Spectrometer	188.00	5	940.00
30	Diffraction Grating	11.50	5	57.50
31	Efficiency of Incandescent Lamp	85.40	5	427.00
	Total	$1044.96		$8372.30

SPACE ALLOTMENT

In my preliminary review of the situation, I found that Physics was being given in many different class-rooms on the campus. This, of course, would be impractical for giving demonstration lectures. I, also, found that there was no storage room or cabinets for the demonstration equipment that was on its way from the United States. Storage cabinets were designed and have been constructed having the features that they can easily be moved and can be adapted for the storage of a variety of apparatus.

Apparently no inventory system was in operation. This has now been set up and is in operation.

Efficiency in presenting demonstration lectures requires assignment of a definite, properly equipped room for this purpose. As a matter of fact it is a necessity. Adjacent to the lecture room should be a storage and preparation room, including some shop facilities. For the College of Agriculture it would be highly desirable to have the laboratories also adjacent to the preparation and storage rooms so that equipment may be easily and quickly set up and taken down between classes.

Dean Cho has set aside a definite room for the physics lectures, shades have been provided so that the room may be darkened and electrical service has been made available. Tentative assignment of space on the same floor in the same building has been made for 2 laboratories, a preparation, storage and shop room, and a dark room.

LIBRARY REFERENCE MATERIALS

The list of English language physics books presently in the Agricultural library was reviewed. Except for 2 or 3 books they are of graduate level and do not support the undergraduate courses because they are too advanced. A number of reference books should be purchased by the library and made available for use by the students and the physics teaching staff.

A list of suitable physics reference books follows. Those marked with an asterisk would be most suitable for the (advanced) Physics students and the remainder satisfactory for the General Physics students.

List of Physics Reference Books Recommended for the Library

I. Textbooks

Title	Authors	Publisher
College Physics	Rusk	Appleton - Century - Crofts
General Physics	Blackwood and Kelly	John Wiley
College Physics	Black and Little	The MacMillan Co.
Practical Physics	White et al	McGraw-Hill
College Physics	Saunders and Kirkpatrick	Henry Holt
Modern College Physics	White	Van Nostrand
Physics	Steward and Gingrich	Ginn and Co.
College Physics	Mendenhall, Eve, Keys and Sutton	Heath and Co.
Physics	Hausman and Slack	Van Nostrand
Analytical Experimental Physics	Ference, Lemon and Stephensen	University of Chicago Press
Physics	Furry-Purcell-Street	Blakiston
University Physico	Sears and Zemansky	(Addison-Wesley) Press, Inc.
Elements of Physics	Shortly and Williams	Prentice - Hall
Physics	Semat	Rhinehart

II. Laboratory Manuals

Title	Authors	Publisher
Physics Laboratory Manual	Wall and Levine	Prentice - Hall
Experiments in Physics	Ingersoll and Martin	McGraw-Hill
Experimental College Physics	White	McGraw-Hill

III. Lecture Demonstration Text

Demonstration Experiments in Physics	Sutton	McGraw-Hill

In addition to the books listed, it is suggested that the journal, American Journal of Physics, published for the American Association of Physics Teachers by the American Institute of Physics, New York, be added to the Library acquisitions. If back numbers for the past 10 years could be acquired there would be formed a useful source of information on new demonstration experiments and new laboratory experiments for the physics instructor to utilize in the future.

CALIBRATION EQUIPMENT

In selecting equipment for the laboratory, apparatus with limited accuracy has been listed for use by the students. If greater accuracy is needed this equipment, for example, electrical meters, can be accurately calibrated by comparison with a standard instrument. Thus it seems desirable to have available somewhere on the campus, standard equipment for calibration purposes for the common physical measurements such as mass, length, voltage, resistance, current, temperature, etc. As research increases and more laboratory instruction is given the need for such a calibration laboratory will become increasingly apparent. It is suggested that such equipment be purchased out of the general college funds and be placed in custody of the Agricultural Engineering Department

and the physics instructor. The equipment could then be displayed to the physics students at the appropriate time and thereby increase its educational value. A list of the equipment for such purpose is given below:

	Cenco Catrlog #	Cost
1 Precision Thermometer (Uncertified) - 10 to 50°C,	19330 A	$ 8.15
1 " " " 0 to 105°C,	19330 D	10.00
1 " " " 0 to 300°C,	19330 F	9.15
	Welch Catalog #	
1 D. C. Voltmeter (Type W) Accuracy .5% of full scale, 150/15/3 volts	3027 S	68.00
1 D. C. Ammeter " " " " " " 10/1/.1 amperes	3024 S	69.00
1 Single phase Wattmeter " " " " " " 5/10 amperes, 100/200 volts	3038 M	107.50
1 A. C. Voltmeter (Type W) Accuracy .5% of full scale, 150/300 volts	3028 H	69.50
1 A. C. Ammeter " " " " " " 5/10 amperes	3028 V	70.00
1 A. C. Ammeter " " " " " " 1/2 amperes	3028 W	70.00
1 Analytical Balance (High grade)		350.00
1 Set, Analytical Weights, Class S, 5 mg. to 100 g.		50.00
1 Leads and Northrup, Type K - 2, Potentiometer		485.00
1 Weston Model 4 Standard Cell, with certificate		49.50
1 Galvanometer and scale, L + N, Type R		160.00
1 Pinch Type Switch, L + N, DPDT		6.00

Additional Demonstration Equipment

All the equipment necessary for demonstration purposes could not be purchased out of the limited 1955-56 budget. It is suggested that the

following list of demonstration equipment be considered for purchase in future allotments.

Supplemental Equipment List for Lecture Demonstrations

Item No.	Quantity	Description	Catalog No. Cenco	Catalog No. Welch	Cost
1	1	Bernoulli's Principle Apparatus	76462		$17.00
2	3	Optical Bench Carrieges	85802	@ 5.98	17.85
3	1	Pulleys, Triple Tandem, Pivot bearing	75650		5.25
4	1	Panel Type, Triplett, A. C. Voltmeter, 0-150 volts			10.00
5	1	Panel Type, Triplett, A. C. Ammeter, 0-10 amperes			10.00
6	1	Laboratory Cost, 36x24x36		55	40.00
7	1 set	Steel, Cadmium plated, Cork Borer 3/16" to 1/2"	12470 B		4.35
8	1	Pulley Hoist, Differential		778	32.50
9	1	Acceleration Apparatus, Pendulum Type		854	56.50
10	1	Plastic Model, Lift Pump		1106	4.50
11	1	Plastic Model, Force Pump		1107	5.00
12	1	Pan with Holder, For items 10 & 11		1109	2.50
13	1	Rotator, complete with motor, 115 volts A. C.	74350 A		95.00
14	1	Centripetal Force Apparatus	74470		22.00
15	1	Ballistic Pendulum, Blackwood	75425		110.00
16	1	Radio Demonstration Outfit	80435		77.00
17	2	Type 801 A, Oscillator Tubes	80436 A	@4.85	9.70
18	1	Mounted Exploring Lamp	80439		1.42
19	1	Standing Wave Tube	80453		12.35
20	1	Neon Wand	80457		1.60

Supplemental Equipment List for Lecture Demonstrations - continued

Item No.	Quantity	Description	Catalog No. Cenco	Catalog No. Welch	Cost
21	1	Convection Box, with glass sides		1727	4.75
22	20	Sheets, Touch paper		1728	2.40 @ .12
23	1	Universal Sonometer, Weight Tension Type		3352	42.50
24	1	Magnetic Attachment, For Sonometers		3365	13.85
25	1	Microphone			20.00
26	1	Audio-amplifier, 10 watts, Hi Fi			80.00
27	1	12" Permanent Magnet, High Quality, Speaker			40.00
28	1	Air Pump, Compression and Vacuum, Large size		1423	26.50
29	1	Alcohol Burner, High Temperature		4776	9.50

Items1 and 2 are replacements for equipment ordered in 1956 but either lost in shipment or not sent by supplier.

Item 3 is needed to supplement the similar pulley on hand in order to perform the intended demonstration.

Items4 and 5 are needed to measure the output of the General Radio, Type V-10 Variac ordered in 1956, order number SK-29, item 215.

It is strongly urged that items 1-7 inclusive be purchased regardless of the decision with respect to the other items. Items 1-5, & 7, are needed to replace or supplement equipment on hand or soon to be received. Item 6 is needed to move equipment easily, safely, and efficiently from the storage and preparation room to the lecture room and back again.

It is highly recommended that all the items be purchased. This equipment together with the physics demonstration equipment already purchased will serve as an excellent foundation of commercially available equipment for demonstration experiments in both general physics and advanced physics.

RECOMMENDATIONS

In order to have physics instruction at a high level it is recommended:

1. That definite space allotments be made for use for physics instruction consisting of the following properly equipped rooms in a group - lecture room; preparations, storage, and shop room; and 2 laboratories to take care of 20 students each at one time.

2. That the course content of the General Physics be changed to include the 5 areas mechanics, heat, sound, electricity and magnetism, and light, since this is a terminal course in physics for most of the students in Agriculture.

3. That course in General Physics be expanded to include laboratory work of 2 hours per week. It would be desirable to increase the number of lectures to 3 per week making a total of 4 credits per semester including laboratory.

4. That the (Advanced) Physics course content be changed to complement the General Physics course and build on the foundation laid in that course. It would be desirable to increase the work in (Advanced) Physics to at least 3 credits per semester.

5. That mimeographed physics notes or texts at the proper level be made available to the students so that the class period may be used for discussion and demonstration of principles and solving example problems.

6. That additional undergraduate level textbooks and laboratory manuals be purchased for the Library and that the American Journal of Physics be added to the journal list.

7. That a technician be employed to set up laboratory and lecture demonstrations, to maintain the equipment, and to build simple demonstration and laboratory equipment.

8. That additional demonstration equipment be purchased to supplement the apparatus already ordered.

9. That the necessary laboratory equipment be purchased as outlined in Appendix D.

10. That standardizing equipment such as thermometers and voltmeters be purchased out of the general college funds to be used for calibration of laboratory and research apparatus.

11. That all the equipment obtained from abroad be carefully inventoried and data such as origin, date, catalog, serial number be kept in a permanent file in order to get repair parts, etc., in the case of need.

12. That someone be sent to the United States for graduate work in Physics with emphasis on learning the skills and techniques of lecture demonstrations and to become familiar with physical measuring instruments of all types.

APPENDIX A

Outline of Physics Courses as Offered 1956 - 1957

General Physics - En 101 - 102

1956 - 1957

Lecturer PAK, Young Kwan

Credits 1 credit per semester (2 class meetings each week)

Text used by lecturer

Physics, Its Laws, Ideas, and Methods
by Alexander Kolin, McGraw-Hill Book Company, Inc. 1950

Materials given to students

Mimeographed material translated into Korean from the text used by the lecturer as a reference. First 12 Chapters, 169 pages, translated.

Topics Included

In 1st Semester (April 3 - July 20, 1956) En 101

Chapter 1. Introduction

" 2. Kinematics: Linear Motion

" 3. Kinematics: Angular motion and curvilinear Trajectories

" 4. Dynamics: 1. Newton's first and second Laws.

" 5. " 2. Newton's third Law and Conservation of momentum

" 6. " 3. Similarity Between Effects of Gravity and of Inertia

" 7. " 4. Vectors and the Generalization of the Concept of Arc.

" 8. " 5. Rotational Motion

" 9. Work and Energy: 1

" 10. Work and Energy: 2

List of Problems

Assigned in 1st Semester

Text questions and Problems (p. 22 - 23) 1, 2, 3, 11

" " " " (p. 31) 1, 2, 3

" " " " (p. 47) 1, 2, 3

" " " " (p. 60) 1, 2, 3

" " " " (p. 71) 1, 2

" " " " (p. 87) 1, 7

" " " " (p. 103) 1, 2, 3

" " " " (p. 107) 1, 2

" " " " (p. 131) 1, 9

Examinations

One examination is given at midterm and another at the end of the term (final). Copy of the final examination for 1st semester follow.

1. Explain examples of d' Alembert's inertial force

2. Explain fundamental Law of Rotational Motion

3. What is meant by each of following terms?

   (1) Impulse, momentum

   (2) Angular impulse, angular momentum

   (3) Moment of inertia

   (4) Moment of force

4. Text p. 30 Example 1 (Modified in numerical values)

5. Text p. 86 Example 4 (" " " ")

Sections and Number of Students

Section No.	Major field of Students	No. of Students
1.	Chemistry Engineering	67
2.	Forestry Livestock	60

Section and Number of Students - continued

Section No.	Major field of Students	No. of Students
3.	Economics Biology	64
4.	Agriculture Sericulture	57
1'	Agric. Teacher Training	61
2'	Home Economics Training	28

Number of Lectures

1st term, 25

2nd term, 32 (tentative)

Tentative Topics for 2nd Semester (Sept. 1, 1956 to Feb. 26, 1957) En 102

Chapter 11 Fluids at Rest

" 12 Fluids in Motion

" 13 Field of Force: 1. The Gravitational Field

" 14 " " " 2. Electrostatic and Magnetostatic Fields

Thermodynamics and Electricity

List of Problems for 2nd Semester

Text - Questions and Problems (p. 149) 1, 7, 8

" " " " (p. 167) 1, 4

" " " " (p. 182) 3, 5,13

List of Demonstration and Laboratory Equipment

Number	Description	Condition
1	Apparatus of Inclined plan	
2	Spring scale	
1	Time-watch	
1	Caliper	
1	Spherometer	

List of Demonstration and Laboratory Equipment - continued

Number	Description	Condition
1	Tuning fork	
1	Apparatus for Kunti Experiment	
1	Prism	
1	Magnifier	
1	Convex lenz	
1	Concave lenz	
1	Apparatus for reflection Experiment	
1	Apparatus for refraction Experiment	
1	Glass rod	
2	Proof plane	
1	Magnet	
1	Electroscope	
2	Electric cell	
2	Galvanometer	
1	Apparatus of Induction coil	
1	Apparatus of Electro-magnetic Induction (Right hand and left hand Rule)	
Total 25		

Advanced Physics - En ( ) and ( )

1956 - 1957

Lecturer PAK, Young Kwan

Sections and Number of Students

1 Section Agric. Engr. (2nd year class) 35 students

Credits 2 credits per semester

Text used by Lecturer

1, Physics, Its Laws, Ideas and Methods
by Alexander Kolin, McGraw-Hill, 1950

2. Physics (written in Japanese 1947)
by Yuba Shigeyasu, Tokyo

Materials given to Students

None

Topics* Included in 1st Semester (April 3 - July 20,1956) En ( )

(1) Character of Heat

The 1st Law of Thermodynamics
The 2nd Law of Thermodynamics

(2) Waves: Transversal and longitudinal; Series of wave, Interference of wave, Stationary wave, Huggens' principle, Reflection and Refraction of wave, velocity and Energy

(3) Sound: Longitudinal sound waves, velocity of sound, musical interval and musical scale principle of Doppler Vibration of cord, Vibration of air Column. Kundt's Experiment

(4) Light: Wave theory of light. Reflection and Refraction velocity Dispersion and chromatic aberation, interference diffraction polarization, double reflection radiation and absorption

(5) Electromagnetic waves:
Electric oscillation, oscillating discharge, Electric resonance Electromagnetic wave, characters, wave detector, Electro magnetic wave theory of light

* Kinematics, dynamics, magnetism and electricity were given in General Physics, En 101 and En 102, to students in the 1st year.

Problems Assigned in 1st Semester

None

Examinations

Copy of the final examination for the first period follows:

1. Polarization of Light

2. 1st Law of Thermodynamics

3. Diffraction of Light

4. Doppler's principle

Number of Lectures

1st Semester, April 3 - July 20, 1956	25 Lectures
2nd Semester, Sept. 1, 1956 - Feb. 26, 1957	32 Lectures (Tentative)

Tentative Topics for 2nd Semester (Sept. 1, 1956 - Feb. 26, 1957) En ( )

1. Electromagnetic waves
   This topics was started in the 1st semester but not completed

2. Spontaneous Transmutation of Elements

3. Artificial Transformation, Creation, Annihilation of the building Blocks of matters

4. The theory of Relativity

Electrical Engineering - En 316

1956 - 1957

Lecturer Pak Young Kwan

Sections and Number of Students

1 section Agric. Engr. (3rd year class) 39 students

Credits 3 credits, a 1 semester course

Text used by Lecturer

General Electrical Engineering
by Osawas, Tokyo, Japan

Material given to Students

None

Topics to be Included 2nd semester, Sept. 1, 1956 to Feb. 26, 1957

Chapter I. General Introduction of Electricity

1. D. C. and A. C.

2. Units of Electricity

Chapter II. Static Electricity

1. Principles of Electrostatics

2. Condensers

3. Electrostatic Phenomena

Chapter III. Electricity and Magneticity

1. Electric Circuits

2. Magnetic Circuits

Chapter IV. A. C.

1. The principle of A. C.

2. The circuits of A. C.

3. The three phase A. C.

4. New symbol system

APPENDIX B

Suggested Outlines for General Physics En 101 and En 102

I. General Physics

En 101

Topic	Number of Lectures
Measurement	2
Units and relationships Equipment for measuring length, mass and time Equations and problem solving	
Density and Specific Gravity	1
Mass density Weight density Specific gravity	
Fluids at Rest	1
Definition of pressure 5 Principles including Archimedes Principle and Pascal's law	
Applications of Fluid Principles	1
Hydrometer Pressure gauges Manometers Bourdon gauge Barometers Mercury Aneroid Fluids in motion	
Equilibrium of Bodies	2
Scalar and Vector quantities Center of gravity Types of equilibrium Conditions for equilibrium $\Sigma F = 0$ $\Sigma F = 0$	
Properties of Materials	1
Elasticity Hooke's law Young's modulus Surface tension	

General Physics - En 101 - continued

Topic	Number of Lectures
Work, Power, Energy	2
Work Power Energy	
Machines	1
Simple machines Friction Efficiency	
Linear Motion	1
Speed and velocity Acceleration Freely falling bodies	
Force and Motion	1
Newton's laws of motion	
Circular Motion	1
Central acceleration Centripetal force	
Measurement of Temperature	1
Temperature scales Thermometers Linear Expansion	
Volume Expansion and Gas Laws	1
Volume Expansion Solids Liquid Gases General Gas Law	
Measurement of Heat	1
Units Method of mixtures	
Mechanical Equivalent and Heat Engines	1

General Physics - En 101 - continued

Topic	Number of Lectures
Heat of Combustion and Energy Values of Fuel and Foods	1
Bomb Colorimeter	
Changes of State	2
Vapors and Vapor pressures - Hygrometry	2
Heat Transfer	2
Conduction	
Convection	
Radiation	
Total lectures 1st Semester	25

II. General Physics

En 102

Topic	Number of Lectures
Electrostatics - Atomic Structure	2
Coulomb's law "Picture" of atoms Charged bodies Conductors and insulators	
Magnetism	2
Natural and artifical magnets Magnetic fields Magnetic induction Earth's field	
Detecting and Measuring an Electric Current	2
Definition of current Spark Chemical method Heating effect Magnetic effect	
Ohm's law - Series and Parallel Circuits	3
Potential difference Resistance and resistance thermometer Ohm's law Electrical circuits	
Electric Power, Rates and Heating	1
"Sources" of Electrical Energy	2
Induction Chemical Action Heat Light Pressure Electromagnetic induction Faraday's discovery	
Wheatstone Bridge, Potentiometer	1

General Physics - En 102 - continued

Topic	Number of Lectures
Alternating Current	2
Definition of current Power in A. C. circuit Transformers House circuits	
Nature and Propagation of Light - Wave Motion	2
Nature of and speed of light Properties of waves Electromagnetic spectrum	
Light Sources and Illumination	2
Reflection and Refraction	2
Law of Reflection Law of Refraction Critical angle and total internal reflection	
Lenses	2
Focal length Thin lens formula	
Optical Equipment	1
Eye Camera Microscope	
Color	2
Visible spectrum Continuous, line and band spectra Color production Subtractive method Additive method	
Polarized light	1
Sound	
Nature, speed, source	

General Physics - En 102 - continued

Topic	Number of Lectures
Modern Physics	3
X-rays Radioactivity Nuclear fission Nuclear fusion	
Total lectures 2nd Semester	32

APPENDIX C

Suggested Topical Outline for "Advanced" Physics

Equilibrium of a Rigid Body (Statics)

Center of Gravity
Conditions for Equilibrium of a body
$\Sigma F = 0$
$\Sigma L = 0$
(Graphical and analytical solutions)
(Use calculus for finding center of gravity)
(Use calculus whenever possible throughout course)

Linear Motion (Kinetics)

Definitions of velocity and acceleration
Linear motion with constant acceleration
Freely falling bodies (g)
Projectile motion

Newton's Laws of Motion (Dynamics)

1st, 2nd, and 3rd laws of motion
Applications
Conservation of linear momentum

Work, Energy, Power

Transformation and conservation of mechanical energy

Rotary Motion

Kinematics of pure rotation
Moment of inertia
Conservation of angular momentum
Combined rotary and linear motion

Periodic Motion

Uniform circular motion
Simple harmonic motion
Pendulum

Fluids in Motion

Bernoulli's Theorem
Venturi flowmeter

Thermodynamics

First law of thermodynamics
Adiabetic and isothermal expension
Carnot cycle
Heat pump

Heat Transfer

Stefin's law
Solar radiation

Wave Motion (General discussion. Applicable to both sound and other wave phenomenons)

Interference)
Diffraction)
Doppler effect)

Acoustics

Complex sounds

Electric Circuits

D.C.
A.C.
Capacitance
Inductance

Reflection and Refraction of Light

Spherical mirrors
Combinations of lenses (compound microscope)
Chromatic aberration

Spectra

Prism Spectrometer
Diffraction Grating

Modern Physics

Thermionic
Photoelectric
Nuclear

APPENDIX D

Detailed List of Equipment Needed for Physics Laboratory

Physics Laboratory - En 101

1st Semester

No. of Exp.	Title of Experiment	Apparatus Needed	Source of Apparatus Exp. #	Cenco	Welch	Cost
2.	**Density of a Solid**					
	1 Micrometer caliper			72655		$10.00
	1 Vernier caliper			72678		5.50
	1 Trip Balance			3470		25.00
	1 Box Weights 10 mg. - 50 grams			9141		2.75
	1 Box Weights 1 gram - 1000 grams			9125D		12.35
	1 Aluminum cylinder (machine to different sizes)			76540		.68
	1 Steel ball 3/4 inch dia.			75205B		.14
		Total Cost				$56.42
3.	Specific Gravity (Archimedes Principle)					
	1 Trip Balance	2				
	1 Support Rod, 13 mm. dia.			72172		1.15
	1 Table Clamp for 13 mm. rod			72355		4.45
or	1 Flush plate base			72125B		1.05
	Weights	2				
	Density cylinder	2				
	1 Lead sinker			76545		.48
	2 Specific Gravity Bottles, 100 ml			10650 @ $2.10		4.20
	1 Aluminum beaker, 1 liter			10200		3.15
		Additional Cost				$14.48
4.	**Equilibrium Forces**					
	1 Force Table			74285		77.00
	2 Pulley, Clamp type			75675 @ $2.85		5.70
	2 Protractors, 6-inch			72985 @ .42		.84
	2 Weight holders			9612 @ 1.20		2.40
	2 Sets of weights			9600 @ 8.00		16.00
		Additional Cost				$101.94

No. of Exp.	Title of Experiment	Apparatus Needed	Source of Apparatus Exp. # Conco	Welch	Cost
5.	Moments				
	1 Demonstration Balance		75560		$ 1.90
	1 Meter stick		73120		1.25
	4 Lever holders		75555 @ .75		3.00
	1 Set of weights		9810		11.50
	1 Trip balance	2			
	Set of Weights	2			
	Lead Sinker	3			
	Additional Cost				$17.65
6.	Surface Tension (Hooke's Law)				
	1 Jolly balance		7560		19.25
	1 Light spring		7508		1.30
	Set of weights	2			
	2 Beaker, 600 ml.		14265 @ .46		.92
	1 Lb. Sodium Hydroxide pellets				.90
	Additional Cost				$22.37
7.	Friction				
	1 Inclined plane		75840		16.80
	1 Friction block		75860		.68
	Weight pan and weights	4			
	2 Weights, 5 grams		9604 @ .65		1.30
	Additional Cost				18.78
8.	Work and Power and Machines				
	1 Inclined plane	7			
	1 Hall carriage		75850		3.75
	1 Hand wheel		77817		26.00
	10 ft. Leather belt, 1/4 inch dia.		78865A @.25		2.50
	2 Spring balances, 25 lbs. capacity		5300 @ 1.25		2.50
	1 Time watch		73516		12.50
	2 Table Clamps		72345 @ 6.95		13.90
	2 Threaded support rod		72186 @ 4.75		9.50
	1 Bench rod, 125 cm. long		72205B		5.10
	2 Clamps, Rt. Angle, 19 mm.		72315B @ 3.95		7.90
	2 Hook collars, 19 mm.		72410C @ 1.95		3.90
	Total Additional Cost				$87.55

No. of Exp.	Title of Experiment	Apparatus Needed	Source of Apparatus Exp.#	Cenco	Welch	Cost
9.	Simple Pendulum					
	1	Pendulum clamp		72296		$ 1.76
	1	Pendulum ball, Aluminum		75070		.95
	1	Pendulum ball, brass, 1 inch dia.		75075B		.70
	1	Pendulum ball, cast iron, 1 inch dia.		75080B		.53
	1	Pendulum ball, cast iron, 1½ inch dia.		75080C		1.20
	1	Spool Nylon cord		88066		1.30
	1	Threaded support rod, 125 cm. long, 19 mm. dia.	8			
	1	Threaded Flush Plate Base for 19 mm. rod		72125C		1.31
		Timer (Time watch)	8			
		Meter stick	5			
		Additional Cost				$ 7.75
10.	Linear Expanrion					
	1	Linear Expansion Apparatus, (micrometer form)		77410		17.60
	1	Aluminum Expansion Rod, 60 cm. long, 6 mm. dia.		77420		.42
	1	Copper expansion rod, 60 cm. long, 6mm. dia.		77424		.85
	1	Electric Buzzer		84020		1.35
		Steam generator and heater	12			
		Thermometer	12			
	5 ft.	Rubber tubing 3/16" inside dia.		18222B		.70
		Meter stick	5			
		Additional Cost				$20.92
11.	Air Thermometer					
	1	Air Thermometer		77325		6.55
	1	Tripod base and rod		77327		4.05
	1	Ice bath vessel, 13 cm. dia. 22 cm. high		76450		5.00
	1	Bath support	12			
	1	Air thermometer bulb		77329		.65
	1 lb.	Mercury				6.30
		Thermometer	12			
		Barometer	Demonstration apparatus			
		Total Additional Cost				$22.55

No. of Exp.	Title of Experiment	Apparatus Needed	Source of Apparatus Exp. #	Cenco	Welch	Cost
12.	**Specific Heat**					
	(1 Steam generator plus			77936		$16.80
	(suitable source of heat			11326		9.50
	or 1 Electric steam generator				1626	16.50
	1 Calorimeter			77970		5.80
	3 Laboratory Grade Thermometers, -10 to 110°, Yellow-backed			19242A @ 1.65		4.95
	1 lb. (454 grams) Aluminum shot			78105A		1.10
	1 lb. (454 grams) Copper shot			78110A		1.30
	1 lb. (454 grams) Lead shot			78115A		1.00
	Trip balance and weights					
	Rubber tubing					
	2 Tubing clamps			12186 @ .16		.32
		Total Additional Cost				$40.77
13.	**Heat of Fusion and Vaporization**					
	1 Calorimeter	12				
	Balance and weights	2				
	2 Thermometers	12				
	Steam generator and accessories	12				
	1 Water trap			77945		.95
		Total Additional Cost				$ .95
14.	**Hygrometry**					
	1 Dew Point Hygrometer (Alluard)				1726	19.50
	2 Thermometers	12				
	5# Ether USP (Ethyl Ether)					3.90
	1 Sling Psychrometer			77005		9.45
	2 Thermometers for Sling Psychrometer			77007 @ 3.00		6.00
	1 doz. Wick for thermometer			76976		.50
		Total Additional Cost				$39.35

Physics Laboratory - EN 102

2nd Semester

No. of Exp.	Title of Experiment	Apparatus Needed	Source of Apparatus Exp. #	Cenco	Welch	Cost
15.	**Magnetic Fields**					
	1 Set steel bar magnets 19 mm. x 6 mm. x 15 cm.			78280		$ 1.60
	1 U magnet poles 13 x 19 m. x 14 cm. long, 5 cm. between poles			78340		1.35
	1 Soft Iron bar 75 x 19 x 6 mm.			78345		.26
	5 Magnetic compasses, 10 mm. dia.			78430A @ .16		.80
	1 Magnetic compass			78445		3.50
	1 Magnet Board			78270		1.80
	1 Carton (1 lb.) iron filings			78395B		.65
	Total Additional Cost					$ 9.96
16.	**Joules Law** (Heating Effect of Electric Current)					
	1 Heating coil (2.5 ohms, 4 amperes)			78025A		7.10
	1 Calorimeter	12				
	1 Thermometer	12				
	1 Rheostat, 22 ohms, 4.4 amp.			82910-13		15.75
	1 Adjustable autotransformer Input 115 volts, 50/60 cycles Output 0-135 volts at 7.5 amperes			80297A		23.00
	1 High resistance A.C. voltmeter, 0-15 volts, 0-150 watts Weston model 528			82652		29.75
	1 A.C. Ammeter 0-5 amp.			82630C		20.00
	1 Timer	8				
	Switches and connecting wires					
	Balances and weights	1				
	Total Additional Cost					$95.60
17.	**Ohm's Law** (Resistance of Lamps)					
	1 Adjustable autotransformer	16				
	1 Lamp, Carbon filament, 115 volts 32 c.p., med. screw base			84445B		.72
	1 Lamp, Tungsten filament, 115 volts, 100 watts					
	1 A.C. Voltmeter, 0-150 volts	16				
	1 A.C. Ammeter, 0-1 amp.			82654B		26.00
	Sockets, switch, connecting wires					
	Total Additional Cost					$26.72

No. of Exp.	Title of Experiment	Apparatus Needed	Source of Apparatus Exp. #	Cenco	Welch	Cost
18.	**Resistances in Series and in Parallel**					
	1 Galvanometer (to be converted to a voltmeter)			82115		$45.00
	1 Multiplier (Resistor) for above galvanometer			82119		27.00
	1 Rectifier unit for use with above galvanometer			82121		12.60
	1 Shunt, .5 amp., for use with above galvanometer			82117B		9.50
	1 Shunt, 1.0 amp., for use with above galvanometer			82117C		9.50
	1 Shunt, 5.0 amp., for use with above galvanometer			82117D		9.50
	Resistor set					
	2 dry cells					
	Switches and wires					
	Total Additional cost					$113.10
19.	**Slide Wire Wheatstone Bridge**					
	1 Slide wire Wheatstone Bridge			83191		12.95
	1 Galvanometer			82115		45.00
	1 Resistance Box (Total resistance = 1110 ohms)			82790		38.55
	1 Set - Resistances			83045		10.75
	2 Dry cells, Standard #6, 1.50 volts each			79145 @ .98		1.96
	Rheostat	16				
	1 Knife switch, DPST			84319		.75
	Wires					
	Total Additional cost					$109.76
20.	**Temperature Coefficient of Resistance**					
	Wheatstone Bridge and accessories	19				
	1 Temperature-coefficient apparatus				2835	15.25
	Thermometer	12				
	Total Additional cost					$15.25

No. of Exp.	Title of Experiment	Apparatus Needed	Source of Apparatus Exp.#	Cenco	Welch	Cost
21.	Potentiometer (Calibration of Ammeter)					
	1 Potentiometer, Students, Cenco - improved design			83400		$53.50
	1 Standard cell, student form with protective resistance			79427		16.00
	1 Galvanometer		19			
	1 Switch, L. & N. Pinch Type, Double Pole, Double Throw			84335		6.10
	1 Standard resistor, 1 ohm, 1 watt accuracy .2%				2826	5.00
	1 Resistance box, Total R = 11,110 ohms			82795		42.50
		Total additional cost				$123.10
22.	Thermocouple					
	Potentiometer and accessories		21			
	1 Multiple Thermocouple			81065		26.35
	2 Thermos Bottles, 500 ml.			10690 @ 1.89		3.78
	Thermometers					
	1 4-ounce spool insulated copper thermocouple wire, #24					2.00
	1 4-ounce spool insulated constantan thermocouple wire, #24					4.00
		Total additional cost				$36.13
23.	Electromagnetic Induction					
	1 Galvanometer		18, 19			
	Buy wire and wind on wooden spools					
	1 Primary coil (200 turns #20 wire)					
	1 Secondary coil (350 turns #24 wire)					
	1 lb. No. 20 copper enameled magnet wire			89561-20		1.90
	1 lb. No. 24 copper enameled magnet wire			89561-24		2.00
	1 20,000 ohm resistor, 1 watt (obtain from radio shop)					.50
	1 Brass bar, dia.= 15 mm. length 15 cm.					.50
	1 Soft iron bar, dia. = 13 mm., length 15 cm.			78350		.21
	1 Steel Bar magnet		15			
		Total additional cost				$ 5.11

No. of Exp.	Title of Experiment	Apparatus Needed	Source of Apparatus Exp.#	Cenco	Welch	Cost
24.	**Alternating Current Series Circuit**					
	1 A.C. Ammeter, 0-1 amp.		17			
	1 A.C. Voltmeter, 0-150 volts		16			
	1 Wattmeter .5/1.0 amp., 100/200 volts				3039M	$79.75
	1 Rheostat, 1400 ohms, .55 amp.			82910-6		15.75
	(1 Fuse and holder, 1 ampere rating)					
	(1 Paper condenser, 8 microfarads, 120 volts	Available from radio shop, Estimate				
	(1 Inductance, .7 henry, 1 ampere					10.00
	1 Lamp, 60 watt - 115 volts					.50
	Switch		19			
		Total Additional Cost				$106.00
25.	**Velocity of Sound - Resonance Tube**					
	1 Resonance Apparatus			84930		34.15
	1 Tuning Fork, 512 cycles/sec.			84560-11		3.75
	1 Tuning Fork, 256 cycles/sec.			84560-3		4.25
	1 Tuning Fork, 320 cycles/sec.			84560-5		4.00
	1 Rubber hammer			84640		2.25
	Thermometer					
	Meter stick					
		Total Additional Cost				$48.40
26.	**Reflection and Refraction**					
	4 Plane mirrors, silvered back, 10 x 10 cm.			85390 @ .15		.60
	2 Packages (6 sheets 4" x 12" in each) cork sheets 3/16" thick			12450B @ 1.25		2.50
	2 plane mirrors, silvered back, 4 x 15 cm.			85385 @ .14		.28
	2 plane mirrors, 8.5 cm. x 5.7 cm.			85380 @ .19		.38
	1 Spherical concave mirror, 4 cm. dia., 25 cm. focus			85405		.85
	1 Spherical convex mirror, 4 cm. dia., 25 cm. focus			85415		.95
	1 Prism, Equilateral, 75 mm. face, 9 mm. thick			85525		1.25
		Total Additional Cost				$ 6.81

No. of Exp.	Title of Experiment	Apparatus Needed	Source of Apparatus Exp. # Cenco	Welch	Cost
27.	Lenses				
	1 Vernier Caliper	2			
	1 Caliper jaws		72690		$ 2.30
	1 Mirror				
	2 Optical Bench Support, Single rod		72220 @ 2.25		4.50
	1 Bench Rod, square, width of faces = 19 mm. length 220 cm.		72210B		7.35
	5 Optical Bench Rod Clamp, Right Angle		72322 @ 2.45		12.25
	2 Clamps, Lens and Mirror		72288 @ 4.20		8.40
	1 Screen		86005		4.05
	1 Object Box		86027		10.00
	1 Double convex lens, Dia.= 5 cm. Focus = 12.5 cm.		85645-6		.90
	1 Double convex lens, Dia. 7.5 cm. Focus = 17.5 cm.		85645-8		2.20
	1 Double concave lens, Dia. = 7.5 cm., Focus = 20. cm.		85650-E		2.75
		Total Additional Cost			$54.70
28.	Optical Instruments				
	1 Optical Bench and accessories	27			
	2 Lenses, Double Convex, Dia. = 3.75 cm., Focus = 5. cm.		85645-1 @ 1.15		2.30
	2 Lenses, Double Convex, Dia. = 3.75 cm., Focus = 10. cm.		85645-2 @ .60		1.20
	1 Lens, Double Concave, Dia.= 3.75 cm. Focus = 10. cm.		85650-A		.90
	1 Lens, Double Convex, Dia. = 10. cm. Focus = 50 cm.		85645-11		4.80
	2 Translucent scales, 6 inches long		73035 @ .11		.22
		Total Additional Cost			$9.42
29.	Spectrometer				
	1 Student Spectrometer			3692	110.00
	1 Mercury-Arc light source			37200	64.50
	1 Cross-hair Illuminator for Student Spectrometer			3692B	13.50
		Total Additional Cost			$188.00

No. of Exp.	Title of Experiment	Apparatus Needed	Source of Apparatus Exp. #	Cenco	Welch	Cost
30.	Diffraction Grating					
	1 Diffraction Grating for student spectrometer				3692A	$11.50
	1 Student Spectrometer		29			
	1 Mercury-Arc light source		29			
		Total Additional Cost				11.50
31.	Efficiency of Incandescent Lamp					
	1 Optical bench		27			
	1 Standard incandescent lamp, 40 watts-115 volts, Tungsten filament			84482		2.15
	1 Universal lamp holder for holding incandescent lamp at different angles			86595		37.50
	1 Right angle clamp, V-opening for 19 mm. sq. rod, 13 mm. hole at right angles			72310B		2.75
	1 Pair Eye shades			86665		6.00
	1 Photometer box, Bunsen-Dibdin, Optical bench type			86455		6.00
	Electrical equipment		16, 17			
	1 General Electric Illumination Meter, 0-70 and 0-700 ft. candles					25.00
		Total Additional Cost				$79.40

SUMMARY

With physics so important in this scientific age not only for its practical values but for its cultural values as well it is essential for the College of Agriculture to further improve its offerings in this basic science. The practical values of physics are readily admitted and generally understood. This is illustrated by the physics requirements in all engineering curricula and in such other applied science fields as geophysics and biophysics.

The cultural values of physics are less understood and are appreciated by few people. In an address given at the annual meeting of the Pennsylvania Conference of College Physics Teachers, Pennsulvania State College, October 14, 1938, and later published in the Journal of Applied Physics, Vol. 10, No. 2, page 86, February, 1939, Mr. David Dietz, Science Editor, Scripps-Howard Newspapers, said in the last section of his paper:

> "I have urged in this address that we shape our educational system so that physics be given the position once occupied by the classics as the common cultural bond that united all educated men. In conclusion let me list the ten cultural values which I have discussed and which, in my opinion, justify this place of honor for the science of physics: (1) Physics is the foundation of the present age and a knowledge of physics is necessary for its complete understanding. (2) Physics seems to be the foundation of every science and all of them can be better understood with an understanding of the principles of physics. (3) The greatest advances of the future will probably be based upon the new discoveries of physics. (4) Our understanding of the cosmos and the picture of the universe given by modern cosmology is founded upon the science of physics. (5) Physics teaches the importance of natural law. (6) Physics teaches precision in observation, experimentation, and deduction. (7) The spirit of physics is the search for the truth. (8) The spirit of physics is the spirit of courage. (9) The spirit of physics is the spirit of tolerance. And, finally, (10) the spirit of physics is the spirit of humanity.
>
> "I call upon you to have courage and to labor with faith for the future of civilization, for the dawn of the day when the spirit of physics, the spirit of all science, will triumph over the forces of blind hatred, of cruel violence, of bigotry and intolerance. God grant that the dawn may be soon."

In the 18 years since Mr. Dietz presented his paper we have had the nuclear (atomic) bomb, the H-bomb and the wide use of nuclear energy and radiations for peaceful purposes. Thus the need for a knowledge of physics by all educated men has increased greatly during the past two decades. Dean Cho and his staff recognize the need for giving their students the educational opportunity of high grade physics instruction.

Several recommendations are given in this report for improving the physics offerings in the College of Agriculture. These include changes in the course outline, making a textbook or its equivalent available to the students, adding to the reference material in the library, assignment of more problems and home work for the students, adding laboratory work, acquiring some additional demonstration equipment, hiring a technician, and further training of staff.

It is my considered opinion that improving the physics instruction to the extent suggested and recommended in this report will benefit all the students, the staff, the University, and Korea. It is a necessity if the College of Agriculture is to retain its leading position in agricultural education.