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COMMISSION ON HIGHER EDUCATION



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Series of 2001

SUBJECT: REVISED GUIDING PRINCIPLES AND MINIMUM
STANDARDS FOR THE BACHELOR OF SCIENCE IN
AGRICULTURAL ENGINEERING PROGRAM

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In accordance with the pertinent provisions of Republic Act No. 7722, otherwise known as the "Higher Education Act of 1994," and by virtue of Resolution No. R4-2001 dated January 9, 2001, the attached revised Guiding Principles and Minimum Standards for the Bachelor of Science in Agricultural Engineering program are hereby adopted for information, guidance and compliance of all concerned.

Pasig City, Philippines January 19, 2001

ESTER ALBANO GARCIA
Chairperson

**GUIDING PRINCIPLES AND MINIMUM STANDARDS FOR
BACHELOR OF SCIENCE IN AGRICULTURAL ENGINEERING PROGRAM**

(Revision of CMO No. 34, Series 1998)

I. GUIDELINES

A. Philosophical framework of the program

Agricultural engineering is a discipline based on the application of engineering principles for the production and processing of food, fiber and materials of biological origin. In the Philippines, agricultural engineering still concentrates on such areas as the irrigation and drainage of agricultural land, soil erosion control, the planning of farm buildings, agricultural waste management and the development of labor-saving farm equipment and systems.

As a discipline that is continuously evolving in response to advances in information technology and bio-technology, changing market needs and policy environments, agricultural engineering is progressively challenged to further improve the efficiency of agricultural systems, and at the same time consciously reduce or eliminate environmental hazards as well as utilize agricultural waste and by-product.

Consistent with its basic nature and directional trends, agricultural engineering education revolves around the philosophy that learning is a continuously recurring process through life for which the learner shall experience and assume responsibility and control. The translation of the above premises into effective instructional resources and facilities is the ultimate responsibility of public and private institutions that offer agricultural engineering as an undergraduate degree program.

B. Objectives of the program

The BS Agricultural engineering (BSAE) program aims to:

1. train students in the application of engineering principles particularly in the solution of problems related to agro-industrial development;
2. prepare them to become professionals with entry-level competencies;
3. develop appreciation in the students, of the potentials of an agricultural engineering business enterprise; and,
4. instill in the students a concern for the preservation and protection of the natural environment.

C. Programs

1. Instruction/curriculum

The curriculum should have a well-balanced general education and strong technical courses aimed at developing students with knowledge, skills, attitude and values.

An institution may offer the BSAE program if it is capable of satisfying the minimum requirement for the basic BSA program.

2. Research and extension

An educational institution offering the BSAE program should provide an environment conducive for the advancement of knowledge in the different fields of agricultural engineering. Knowledge gained through research should be effectively transferred to the countryside to accelerate agricultural development and improve the quality of life in the rural areas.

D. Resources

1. Faculty

There should be highly qualified registered professional agricultural engineers to teach professional agricultural engineering courses in the BSAE program.

2. Physical facilities and equipment

Adequate physical facilities and equipment should be available to insure quality offering of the BSAE program.

E. Admission policy

The institution should adopt an admission policy which provides equal access to students from lower income groups without sacrificing academic standards.

F. Organization

The staff of the institution should be properly organized in such a way that its activities in instruction, research and extension could be properly implemented.

G. Quality of output

Graduates of the BSAE program should pass the board examination for agricultural engineers to practice their profession.

II. MINIMUM STANDARDS

A. Programs

1. Instruction/curriculum

The minimum units required for the BSAE program is 186.

The minimum aggregate number of units or credit hours is 186 and as a rule one unit means one hour of lecture per week and three hours of laboratory per week.

2. Research and extension

Research and extension funds and facilities must be provided to enable the faculty to do the creative research work. The faculty should therefore be allotted load credits for official time devoted to research and extension work.

Research and extension funding could come from internal and or external sources.

Applied research and extension programs should be established to meet the development needs of the region and to provide dynamism and relevance to the instructional program.

B. Resources

1. Faculty

In addition to the faculty for general education and fundamental agriculture, there should be a minimum faculty of five (5) full-time instructors who are registered professional agricultural engineers. One instructor should be assigned in any of the following major areas: Soil and Water Resources; Agricultural Power and Machinery; Agricultural Structures and Environment; and Agricultural Processing and Electrification.

Fifty percent (50%) of the full-time faculty members should have advanced degrees in any of the above fields.

The institution should have a maximum faculty student ratio of 1:20 using the full-time equivalent (FTE) for teaching as basis.

2. Physical facilities and equipment

The institution offering the BSAE program should have physical facilities and equipment for instruction research and development as follows:

a. Building requirements

1. School Building

The school building for the agricultural engineering program should be able to accommodate students comfortably and should comply with appropriate zoning and building regulations.

2. Laboratories

The institution should have the following laboratory units available to agricultural engineering students: Soil and Water, Agricultural Power and Machinery, Agricultural Processing, Farm Electrification; drafting room; Agricultural Structures; Metal and Woodworking Shop; Computer laboratory with Computer-Aided Design equipment and software.

The laboratory space requirements are as follows:

- a. Floor space of 2.3 sq. m. per student
- b. maximum of 30 students per laboratory class.

- c. Circulation should be approximately 30 percent of the sum of the areas of all teaching accommodation (including storage), library administrative and food services.

The institution should have the basic minimum laboratory equipment for research and instruction.

3. Classroom

The classroom requirements for agricultural engineering courses are as follows:

- a. Floor space of 1.5 sq.m. per student
- b. A maximum of 30 students per lecture class

b. Library

1. Library seating capacity should be 10 percent of the combined total of students and academic staff.
2. There should be a minimum of two (2) text book titles (latest available edition per subject for the general education, fundamental agriculture courses and basic engineering courses at least three book titles (latest available edition) for each major subject.
3. A minimum of two current agricultural engineering technical journals preferably one local and one foreign should be made available.

C. Organization

The educational institution offering BSAE program in agricultural engineering must have a distinct and duly recognized division/department of agricultural engineering to specifically take charge of planning and implementation of its instruction, research and extension activities. The head of the unit must be a registered professional agricultural engineer duly appointed by the school administrator and given administrative load credits.

BACHELOR OF SCIENCE IN AGRICULTURAL ENGINEERING
MINIMUM REQUIREMENTS

	Courses	Units	Percentage
I.	GENERAL EDUCATION	51	27
	Language and Humanities	21	
	Mathematics, Nat. Sci. and Information Technology	15	
	Social Sciences	12	
	Rizal Course	3	
II.	PREPARATORY SUBJECTS	27	15
III.	FUNDAMENTAL AGRICULTURE	15	8
	Animal Science	3	
	Crop Science	3	
	Fishery Science	3	
	Soil Science	3	
	Agricultural Entrepreneurship and Management	3	
IV.	BASIC ENGINEERING	44	24
	Engineering Mechanics	5	
	Thermodynamics and Heat Transfer *	5	
	Fluid Mechanics	4	
	Surveying	3	
	Engineering Graphics	3	
	Materials of Engineering	3	
	Introduction to Operations Research	3	
	Agricultural Engineering and Professional Ethics	1	
	Strength of Materials	3	
	Engineering Economy	3	
	Computer Applications in Engineering	6	
	Farm Shop Practice	2	
	Principles of Electricity and Electronics	3	
V.	PROFESSIONAL AGRICULTURAL ENGINEERING COURSES	42	23
	Soil and Water Resources	12	
	Agricultural Power and Machinery	9	
	Agricultural Processing, and Electrification	9	
	Agricultural Structures and Environment	12	
VI.	THESIS/ FIELD PRACTICE	6	3
VII.	UNDERGRADUATE SEMINAR	1	1
VIII.	PHYSICAL EDUCATION	(8)	
IX.	MILITARY SCIENCE	(6)	
		186	

* can be taken as one course with 5 units or separately at 3 units each.

BACHELOR OF SCIENCE IN AGRICULTURAL ENGINEERING

Courses	Units
I. GENERAL EDUCATION	51
A. Language and Humanities	21
<u>English</u>	
1. Communication Skills I	3
2. Communication Skills II	3
<u>Filipino</u>	
1. Kasanayan sa Komunikasyon	3
2. Paktorikong Pilipino	3
<u>Humanities</u>	
1. Humanities I - Literature, Man and Society	3
2. Humanities II - Art, Man and Society	3
3. Humanities III - Introduction to Philosophy and Logic	3
B. Mathematics, Natural Science and Information Technology	15
<u>Mathematics</u>	
1. Algebra	3
2. Plane Trigonometry	3
3. Introduction to Computer Science	3
<u>Natural Sciences</u>	
1. Biology	3
2. Inorganic Chemistry	3
C. Social Sciences	12
1. Introduction to Behavioral Science	3
2. Principles of Government, Politics and Constitution	3
3. Principles of Economics	3
4. Rural Sociology and Institutions	3
D. Philippine Institution (Life and Works of Rizal)	3
II. PREPARATORY COURSES	27
1. Speech Communication*	3
2. Scientific and Technical Writing	3
3. Analytic Geometry and Calculus I	3
4. Analytic Geometry and Calculus II	3
5. Analytic Geometry and Calculus III	3
6. Elementary Statistics	3
7. Organic Chemistry	3
8. General Physics I	3
9. General Physics II	3

* Or any of the following: Business English; Technical English or World Literature; Philippine Regional Literature; Asian Literature; Third World Literature.

III. FUNDAMENTAL AGRICULTURE		15
1. Animal Science	3	
2. Crop Science	3	
3. Fishery Science	3	
4. Soil Science	3	
5. Agricultural Entrepreneurship and Management	3	
IV. BASIC ENGINEERING		44
1. Engineering Mechanics	5	
2. Thermodynamics and Heat Transfer	5	
3. Fluid Mechanics	4	
4. Surveying	3	
5. Engineering Graphics	3	
6. Materials of Engineering	3	
7. Introduction to Operations Research	3	
8. Agricultural Engineering Law and Professional Ethics	1	
9. Strength of Materials	3	
10. Engineering Economy	3	
11. Computer Applications in Engineering	6	
12. Farm Shop Practice	2	
13. Principles of Electricity and Electronics	3	
V. PROFESSIONAL AGRICULTURAL ENGINEERING COURSES		42
<u>Soil and Water Resources</u>		12
1. Irrigation and Drainage Engineering	3	
2. Soil and Water Conservation	3	
3. Hydrology	3	
4. Aquaculture Engineering	3	
<u>Farm Power and Machinery</u>		9
1. Agricultural Mechanization and Machine Management	3	
2. Agricultural Power and Energy Sources	3	
3. Agricultural Machinery Design	3	
<u>Agricultural Processing and Electrification</u>		9
1. Farm Electrification	3	
2. Agricultural Processing and Handling	3	
3. Refrigeration Engineering	3	
<u>Agricultural Structures and Environment</u>		12
1. Agricultural Waste Management	3	
2. Farm Structures Engineering	3	
3. Design and Management of Farm Structures	3	
4. Forest Products Engineering	3	
VI. THESIS/FIELD PRACTICE *		6
VII. UNDERGRADUATE SEMINAR		1
VIII. PHYSICAL EDUCATION		(8)
IX. MILITARY SCIENCE		(6)
		<hr/> 186

* An option is given to the student to take either six units of thesis or field practice

BACHELOR OF SCIENCE IN AGRICULTURAL ENGINEERING

Sample Curriculum

FIRST YEAR

First Semester

<u>Subjects</u>	<u>Hrs./Week</u> <u>Lec-Lab</u>	<u>Units</u>
General Biology	2-3	3
Inorganic Chemistry	2-3	3
Introduction to Computer Science	2-3	3
Algebra	3-0	3
Communication Skills I	3-0	3
Introduction to Behavioural Sciences	3-0	3
Physical Education		(2)
ROTC 11*		(1.5)
		<hr/>
		18

Second Semester

<u>Subjects</u>	<u>Hrs./Week</u> <u>Lec-Lab</u>	<u>Units</u>
Organic Chemistry	2-3	3
General Physics I	2-3	3
Plane Trigonometry	3-0	3
Kasanayan sa Komunikasyon	3-0	3
Communication Skills II	3-0	3
Principles of Government and Political Thought	3-0	3
Physical Education	3-0	(2)
ROTC 12*		(1.5)
		<hr/>
		18

* Required for all male students.

SECOND YEAR

First Semester

<u>Subjects</u>	<u>Hrs./Week</u> <u>Lec-Lab</u>	<u>Units</u>
Principles of Soil Science	2-3	3
Principles of Crop Science	2-3	3
General Physics II	2-3	3
Analytic Geometry and Calculus I	3-0	3
Scientific and Technical Writing	3-0	3
Paklorikong Filipino	3-0	3
Physical Education III		(2)
ROTC 21 *		(1.5)
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		18

Second Semester

<u>Subjects</u>	<u>Hrs./Week</u> <u>Lec-Lab</u>	<u>Units</u>
Introduction to Animal Science	2-3	3
Engineering Graphics	1-6	3
Analytic Geometry and Calculus II	3-0	3
Principles of Economics	3-0	3
Principles of Electricity and Electronics	3-0	3
Speech Communication	3-0	3
Physical Education IV		(2)
ROTC 22 *		(1.5)
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		18

* Required of all male students

THIRD YEAR

First Semester

<u>Subjects</u>	<u>Hrs./Week</u> <u>Lec-Lab</u>	<u>Units</u>
Elementary Statistics	2-3	3
Farm Electrification	2-3	3
Engineering Mechanics	3-6	5
Principles of Fishery Science	2-3	3
Humanities I – Literature, Man and Society	3-0	3
Analytic Geometry and Calculus III	3-0	3
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		20

Second Semester

<u>Subjects</u>	<u>Hrs./Week</u> <u>Lec-Lab</u>	<u>Units</u>
Social Science IV, Rural Sociology and Institutions	3-0	3
Strength of Materials	3-0	3
Farm Shop Practice	1-6	2
Fluid Mechanics	3-3	4
Engineering Economy	3-0	3
Humanities II - Art, Man and Society	3-0	3
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		18

FOURTH YEAR

First Semester

<u>Subjects</u>	<u>Hrs./Week Lec-Lab</u>	<u>Units</u>
Computer Applications in Engineering I	2-3	3
Surveying	1-6	3
Thermodynamics and Heat Transfer	3-6	5
Materials of Engineering	2-3	3
Agricultural Entrepreneurship and Management	3-0	3
Life and Works of Rizal	3-0	3
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		20

Second Semester

<u>Subjects</u>	<u>Hrs./Week Lec-Lab</u>	<u>Units</u>
Hydrology	2-3	3
Aquaculture Engineering	3-0	3
Agricultural Engineering Law and Professional Ethics	1-0	1
Forest Products Engineering	3-0	3
Farm Structures Engineering	3-0	3
Agricultural Power and Energy Sources	2-3	3
Computer Applications in Engineering II	2-3	3
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		19

FIFTH YEAR

First Semester

<u>Subjects</u>	<u>Hrs./Week</u> <u>Lec-Lab</u>	<u>Units</u>
Irrigation and Drainage Engineering	2-3	3
Design and Management of Farm Structures	2-3	3
Refrigeration Engineering	2-3	3
Introduction to Operations Research	2-3	3
Thesis/Field Practice		3
Seminar		1
Humanities III - Introduction to Philosophy and Logic	3-0	3
		<hr/> 19

Second Semester

<u>Subjects</u>	<u>Hrs./Week</u> <u>Lec-Lab</u>	<u>Units</u>
Agricultural Mechanization and Machine Management	2-3	3
Agricultural Waste Management	2-3	3
Thesis/Field Practice		3
Soil and Water Conservation	2-3	3
Agricultural Processing and Handling	2-3	3
Agricultural Machinery Design	2-3	3
		<hr/> 18
	Total Units	186

SUMMARY

	Units
FIRST YEAR	36
First Semester	18
Second Semester	18
SECOND YEAR	36
First Semester	18
Second Semester	18
THIRD YEAR	38
First Semester	20
Second Semester	18
FOURTH YEAR	39
First Semester	20
Second Semester	19
FIFTH YEAR	37
First Semester	19
Second Semester	18
	<hr/> Total Units
	186

DESCRIPTION OF COURSES

Language and Literature

- Communication Skills I (3 units). 3 hours/week (class). Basic skills of listening, speaking, reading and writing.
- Communication Skills II (3 units). 3 hours/week (class). Intermediate skills of listening, speaking, reading and writing. Prerequisite: English I.
- Speech Communication (3units). 3 hours/week (class) or any of the following: Business English; Technical English or World Literature; Philippine Regional Literature; Asian Literature; Third World Literature.
- Scientific and Technical Writing (3units). 3 hours/week (class). Principles underlying the prerequisites and writing of scientific papers.
- Kasanayan sa Komunikasyon (3 units). 3 hours/week (class). Mga paraan tungo sa mabisang pagpapahayag sa wikang Filipino na nakatuon sa mapanuring pakikinig, pagbasa, pagsulat at pagsasalita.
- Poklorikong Filipino (3 units). 3 hours/week (class). Mga pagbabasa at pag-unawa ng Poklorikong Filipino tungo sa pagkilala sa tanay na karikitan at kahulugan ng buhay.

Mathematics and the Natural Sciences

Mathematics

- Algebra (3 units). 3 hours/week (class). Sets, real number system; radicals and rational exponents; linear equations and inequalities; quadratics; system of equations; functions.
- Plane Trigonometry (3 units). 3 hours/week (class). Functions and relations; logarithms and applications; circular and trigonometric functions and their inverses; solutions of right and oblique triangles.
- Analytic Geometry and Calculus I (3 units). 3 hours/week (class). Straight lines, functions and graphs; limits and continuity of concepts; derivatives of algebraic functions; differential applications to curve sketching; related rates; maxima and minima problems; equations of the second degree; the indefinite integral and its applications; areas under a curve; the definite integral
- Analytic Geometry and Calculus II (3 units). 3 hours/week (class). Differentiation and integration of transcendental functions; indeterminate forms; integration formulas and procedures; applications of integration; polar coordinate system.
- Analytic Geometry and Calculus III (3 units). 3 hours/week (class). Parametric equations, vector and solid analytic geometry; partial differentiation; multiple integrals; infinite series.
- Elementary Statistics (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Basic statistical concepts; frequency tables and distributions; sampling; tests of significance; regression and correlation; introduction to analysis of variance and experimental designs.
- Introduction to Computer Science (3 units). 5 hours a week (2 hours lecture, 3 hours laboratory). Introduction to the major areas of computer science; software systems and methodology; computer theory; computer organisation and architecture.

Natural Sciences

- General Biology (3 units).** 5 hours/week (2 hours lecture, 3 hours laboratory). The origin and evolution of life; cell metabolism and energy transformation; system regulation; population dynamics; community and ecosystems.
- Inorganic Chemistry (3 units).** 5 hours/week (2 hours lecture, 3 hours laboratory). Theoretical aspects of inorganic chemistry; a systematic study of the properties of the elements from the point of view of modern atomic structure.
- Organic Chemistry (3 units).** 5 hours/week (2 hours lecture, 3 hours laboratory). Organic structural theory and introduction to reaction mechanism, structure, properties and nomenclature of hydrocarbons, alkyl and aryl halides, alcohols and phenols, ethers and epoxides; introduction to stereo-chemistry and elementary organic synthesis.
- General Physics I (3 units).** 5 hours/week (2 hours lecture, 3 hours laboratory). Inertia, motion, forces and energy properties and laws of solids and liquids, temperature measurements and effects on properties of materials and heat flow.
- General Physics II (3 units).** 5 hours/week (2 hours lecture, 3 hours laboratory). Sources, effects, measurements and uses of electricity and magnetism, fundamentals of wave motion applied to the study of sound and light.

Humanities and Social Sciences

Humanities

- Humanities I - Literature, Man and Society (3 units).** 3 hours/week (class). A study of the various literary masterpieces as imaginative expression of the individual writers experience and society's values and ideals.
- Humanities II - Art, Man and Society (3 units).** 3 hours/week (class). A study of the visual arts and music as products of the creative imagination and dynamic interaction with society.
- Humanities III - Introduction to Philosophy and Logic (3 units).** 3 hours/week (class). Application of the basic concepts, skills, principles and knowledge drawn from philosophy of language, symbolic logic, Epistemology, Philosophy of Science and Ethics.

Social Sciences

- Introduction to Behavioural Sciences (3 units).** 3 hours/week (class). Basic principles, theories, concepts and processes of human behaviour; the social, cultural and psychological bases of contemporary Philippines conditions with emphasis on population education, social change and rural development.
- Principles of Government and Political Thought (3 units).** 3 hours/week (class). The principles and concepts of political sciences, especially as they apply to the Philippines; the historical development of political institutions from pre-Spanish times to the present with special emphasis on the New Constitution.
- Principles of Economics (3 units).** 3 hours/week (class). Introduction to Economics. Basic Concepts of macroeconomics, money and banking, economic growth and development and international economics.
- Rural Sociology and Institutions (3 units).** 3 hours/week (class). Analysis of rural communities and rural institutions as they respond to and are affected by technological, social, economic and environmental policies and factors both within and outside the rural sector.

Philippine Institution 100 - Rizal. (3 units). 3 hours/week (class). The life and works of Jose Rizal.

Fundamental Agriculture

Introduction to Animal Science (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Principles of breeding, physiology and nutrition in relation to production, processing and marketing of animal products.

Fundamentals of Crop Science (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Principles and practices of crop science.

Principles of Fishery Science (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Principles of physiology, breeding and nutrition in relation to fishery production

Principles of Soil Science (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Nature, properties and management of soils.

Agricultural Entrepreneurship and Management (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Principles underlying management and their application on agricultural business, offices and programs; planning, management and control of agricultural projects.

Basic Engineering

Engineering Graphics (3 units). 7 hours/week (1 hour lecture, 6 hours laboratory). Basic drafting operations and tools; techniques of pictorial representation; geometric construction; technical drafting practice.

Prerequisite: Algebra and Trigonometry

Principles of Electricity and Electronics (3 units). 3 hours/week (class). Electric circuits, electronic devices and circuitry, electro-magnetic devices; single and polyphase circuits.

Prerequisite: General Physics 2

Engineering Mechanics* (5 units). 9 hours/week (3 hours lecture, 6 hours laboratory). Fundamental principles of equilibrium of rigid bodies; first and second moment of mass, volume, area and length; static equilibrium of rigid bodies in rectilinear, curvilinear and planar motion; force, mass and acceleration; impulse and momentum; mechanical vibrations.

Prerequisite: General Physics 2 and Analytic Geometry and Calculus III

Strength of Materials (3 units). 3 hours/week (class). Elementary stress and strain analysis; analysis and design of structural elements based on static equilibrium and material properties.

Prerequisite: Engineering Mechanics

Farm Shop Practice (2 units). 7 hours/week (1 hour lecture, 6 hours laboratory). Woodworking, metal working, plastic forming, ceramics, concrete and masonry.

Fluid Mechanics (4 units). 6 hours/week (3 hours lecture, 3 hours laboratory). Principles of fluid properties, fluid statics, hydraulics, hydromechanics and aerodynamics; properties of newtonian and non-newtonian fluids.

Prerequisite: Engineering Mechanics

*This course may be offered separately as Statics (3 units) and Dynamics (3 units).

Engineering Economy (3 units). 3 hours/week (class). Cash flow discounting; depreciation cost estimation; economic analysis of engineering projects.

Prerequisite: Principles of Economics

Computer Applications in Engineering I (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). An introduction to the use of computers in engineering; algorithms and flowcharts; application programs.

Prerequisite: Introduction to Computer Science

Computer Applications in Engineering II (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). An introduction to object-oriented computer programming; program design, testing and debugging based on engineering applications.

Prerequisite: Computer Applications in Engineering I

Surveying (3 units). 7 hours/week (1 hour lecture, 6 hours laboratory). Use and adjustment of surveying instruments; methods of running traverses and levelling; topographical surveys.

Prerequisite: Algebra and Trigonometry

Thermodynamics and Heat Transfer* (5 units). 9 hours/week (3 hours lecture, 6 hours laboratory). Basic laws of thermodynamics; gas and vapour characteristics and mixtures. Analysis and application of steady-state and transient heat conduction; radiant heat transfer; spectral properties and radiation networks; natural and forced convective transfer of heat and mass in boundary layers and in fluids with phase change.

Prerequisite: Analytic Geometry and Calculus III

Materials of Engineering (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Properties of engineering materials, evaluation and selection of materials; standard materials specification.

Prerequisite: Strength of Materials

Agricultural Engineering Law and Professional Ethics (1 unit). 1 hour/week (class). The Philippine Agricultural Engineering Law; project specifications, bids and awards; contract preparation; and professional ethics.

Prerequisite: Senior Standing

Introduction to Operations Research (3 units). 3 hours/week (class). Resource allocation and scheduling models as applied to engineering problems; quantitative methods to decision making.

Prerequisite: Computer Applications in Engineering I and Elementary Statistics

Professional Courses

Soil and Water Resources

Irrigation and Drainage Engineering (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory).

Basic soil-plant-water relationships; flow measurements; selection of pumps; survey of irrigation and drainage systems; planning and design of drainage and irrigation system

Prerequisite: Hydrology and Surveying

Soil and Water Conservation (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Design, construction and maintenance of water conservation works; drainage and erosion control systems.

Prerequisite: Irrigation and Drainage

Hydrology (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). The hydrologic cycle; streamflow hydrographs; frequency analysis; groundwater hydrology; water quality analysis; mathematical models for data synthesis.

Prerequisite: Fluid Mechanics

* This course may be offered separately as Thermodynamics (3 units) and Heat transfer (3 units).

Aquaculture Engineering (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Principles of planning aquaculture systems; layout of farm facilities.
Prerequisite: COI

Agricultural Power and Machinery

Agricultural Mechanization and Machine Management (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Agricultural mechanization needs assessment; design of farm implements; selection of seeding and harvesting machines; machinery management;
Prerequisite: Agricultural Machinery Design

Agricultural Power and Energy Sources (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Thermodynamics, operation, adjustments, testing and fuel and lubricant requirements of internal combustion engines; uses of non-conventional energy sources.
Prerequisite: Thermodynamics

Agricultural Machinery Design (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Design of machine elements in agricultural equipment.
Prerequisite: Engineering Mechanics

Agricultural Processing, Storage and Electrification

Farm Electrification (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Application and utilisation of electric power; generators and motors; electrical equipment and control; distribution lines; power load calculations.
Prerequisite: Principles of Electricity and Electronics.

Agricultural Processing and Handling (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Principles of drying and storage of agricultural products; agricultural processing and handling equipment; operations and maintenance; design of agricultural processing systems.
Prerequisite: Thermodynamics and Heat Transfer

Refrigeration Engineering (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Refrigeration cycle; analysis of vapour compression refrigeration systems; refrigerants and their properties; application of psychrometrics and in air-conditioning and cold storage; cooling load calculations.
Prerequisite: Thermodynamics and Heat Transfer

Agricultural Structures and Environment

Agricultural Waste Management (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Survey of agricultural wastes; analysis and design of agricultural waste management systems.
Prerequisite: Design and Management of Farm Structures

Farm Structures Engineering (3 units). 3 hours/week (class). Theory of stress analysis as applied to statically indeterminate structures subjected to static and dynamic loads; algebraic and graphical analysis of beams, trusses, portals and frames of farm buildings.
Prerequisite: Materials of Engineering

Design and Management of Farm Structures (3 units). 5 hours/week (2 hours lecture, 3 hours laboratory). Engineering principles and design criteria for farm structures with emphasis on farm buildings; cost estimates and specifications; farm structures maintenance and management.
Prerequisite: Farm Structures Engineering

Forest Products Engineering (3 units) 5 hours/week (2 hours lecture, 3 hours laboratory)
Engineering properties of wood; survey of forest products manufacturing processes; handling, transport, processing and utilization of forest products.
Prerequisite: Senior Standing

Minimum Laboratory Equipment and Facilities
(for 25 students)

I. SOIL AND WATER RESOURCES LABORATORY

Required

A. Surveying

<u>Item/Description</u>	<u>Quantity</u>
Hand levels	2 pcs.
Engineer's transit or EDM*	2 pcs.
Wooden Rods, metric	4 pcs.
Steel tapes, metric	4 pcs.
Range poles	5 pcs.
Chaining pins	22 pcs.
Polar planimeter	2 pcs.
Store room and/or cabinets	1 pc.
Stereoscope	1 pc.

B. Hydraulic Laboratory with the following equipment and facilities

B.1	Flow measuring device	1 pc.
	Orifice	1 pc.
	Parshall flume	1 pc.
	Cirpoletti weir	1 pc.
	Triangular weir	1 pc.
	Rectangular weir	1 pc.
	Current meter	1 pc.
B.2	Pressure measuring devices	
	Manometer	1 set
B.3	Water reservoir and piping valves and fitting	1 set
B.4	Pumps	
	Pumps and fittings preferably centrifugal pump	1 set
	Other pumps	
	Diaphragm	
	hydraulic ram	
	piston/reciprocating	

*EDM - Electronic Distance Measurement Instrument

<u>Item/Description</u>	<u>Quantity</u>
B.5 Soil and Water Analysis	
Hydrometers	2 pcs.
Triple beam balance with set of weights	2 pcs.
1 L. cylinder	4
1 L. graduated cylinder	2 pcs.
100 ml. Beaker	10 pcs.
600 ml. Beaker	10 pcs.
1 L. Beaker	1 pc.
1 hot plate/stirrer	1 pc.
Sieves	1 pc.
Double ring infiltrometer ³	1 set
Hydraulic conductivity set up	1 set
Soil auger	1 set
pH meter	1 pc.
Conductivity meter	1 pc.
Tensiometers with manometers	2 pcs.
Convection type drying oven	1 pc.
Aluminum sample container with lead water quality test kit soil moisture meter	1 set
B.6 Models for Illustrations	
Flumes	
Siphons	
Drops	
Transition	
Chutes	
Division box	
Culvert	
Turnouts	
Checks	

II. AGRICULTURAL POWER AND MACHINERY

Required

A. Farm Power Laboratory

Single-cylinder, 4 stroke, spark ignition engine	1
Single-cylinder, 4 stroke, compression-ignition engine	1
Prony brake or dynamometer	1
Set of mechanics tools	1
open wrench	1 set
screw driver	1 set
buck wrench	1 set
mechanical pliers	1
Volt-ohm-milliammeter	1
Compression tester	1
Transmission differential set	1
Nozzle tester	1

<u>Item/Description</u>	<u>Quantity</u>
B. Farm Machinery Laboratory	
Tractor (either 2 or 4 wheels) with operational and standard Attachments	1
Animal drawn plows and harrows	1
Planters	
Row crop	1
Chemical applicators	
Knapsack sprayer	1
Harvesting tools	
Thresher/or equivalent for other crops prevailing in the area	1
Air Compressor	1
Dynamometer	1
2-wheel trailer	1

III. AGRICULTURAL PROCESSING LABORATORY

A. Grain testing laboratory	
Trier for sack, small (18")	1
Trier for storage bin, long (1m) with divisions	1
Dividing trays	2
Electronic moisture meter	1
Aspirator	1
Protractor	1
Slotted sieve (1.75 mm)	2
Grain pans	2
Magnifying glass	1
Fractional distillation Moisture tester	1
Sensitive balance (mettler-type)	1
Electronic oven with temperature control	1
Thermometers, 0 - 120° C	2
Bulk density tester	1
Set of sieves	1
Glass dessicators	2
B. Drying	
Torsion balance, 1 kg. Capacity	1
Laboratory dryer with temperature and air flow control, capacity for 3 drying bins (1 kg. Cap.)	1
Inclined manometer with pitot tube	1
Air flow test duct with fan and motor	1 set
Clamp-on power meter	
Psychrometer or hygrometer	

Item/Description	Quantity
IV. ELECTRIFICATION	
A. Rural Electrification Laboratory	
Portable AC generator, 1.5 kw	1
Frequency meter	1
Kilowatt-hour meter	1
Tachometer, 3000-5000 rpm	1
Volt-ohm-milliammeter (VOM), AC/DC	2
Wattmeters, 1,500 W	2
AC Ammeter, Clamp-on type, 10 amp range	1
Electricians tools	1 set
AC Voltmeter, 300 Voltrange	2
Set of screw drivers	
Assorted single-phase electronic motors, any size	
universal motor	1
split-phase motor	1
capacitor-start motor	1
Three-phase motor, any size	1
Service entrance switch, 60 - 100 amp	1
15-amp circuit breaker, 220V	2
Power box, with 15 amp circuit breaker, 220V	1
Transfer switch, DPDT, Knife-edge type	1
Assorted electrical switches	
SPST	2
SPDT	2
DPDT	2
magnetic relay, 220V	1
magnetic motor starters with push-button switches, 220V	2
Fuse box, 30-60 amp, Knife-edge type	1
time switch	1
thermostat	1
humidstat	1
pressure stat	1
Load boards for resistive loads	2
Connecting wires, gauge 14, stranded, 18" long	24
Display board for assorted wire types	1
Display board for types of wire connections	1
Assorted junction boxes	4
B. Refrigeration	
Instructional model Refrigeration system (vapor compression)	1 unit
Instructional model Refrigeration system (absorption type)	1 unit
High and low pressure test gauge with connecting hose	1 set
Halide torch leak detector	1
Bending tool, spring type	1 set
Pinch-off tool, 7"	1
Pipe cutter 3/16" - 1 1/8"	1
Flaring tool	1

<u>Item/Description</u>	<u>Quantity</u>
Dial thermometers, 8" - 10 to 50°C range	2
Vacuum pump with gauge	1
Psychrometer, aspirated type, battery operated	1
Thermostats	2
Hand expansion valve	1
Capillary tube	1
Thermostat expansion valve	1
Open wrench	1 set
Adjustable wrench, 8"	1
Refrigerant cylinder, 2 kg. capacity	1
Airconditioner (window type) instructional model	1 unit
V. DRAFTING ROOM	
Drafting tables, 36" x 48" and stools	25 sets
Drafting equipment	1 set
VI. AGRICULTURAL STRUCTURES	
Required	
Truss Models (local construction)	
Building Frame models (local construction)	
Models and/or illustrations of other agricultural structures (local construction)	
Optional Requirements:	
Concrete mixer, one bagger	
Forming frame for steel works (local construction)	
Tension machine with load indicator, 20,000 lb. cap. (local construction)	
Compression machine with load indicator 20,000 lb. cap. (local construction)	
Flexural test accessories of item 1.2 (local construction)	
Torsion test machine (local construction)	
Shear test accessories of item 1.2 (local construction)	
Dial gauge deflection (offshore procurement)	
Strain gauge meter (offshore procurement)	
Loading machine for buckling test of columns (local construction)	
Simple prestressing equipment (offshore procurement)	
Wind pressure test chamber (local construction)	
Earthquake simulator (local construction)	
Universal testing machine	
VII. ENGINEERING SHOP	
A. Forges	
Forges	2
Anvils	2
Sledge hammers	2
Tons (circular, flat)	4
Set hot chisel	1
Flatters	2
Ballpeen hammer, assorted sizes	4
Viscs, blacksmith	2

B. Foundry and Heat Treatment	1
Furnace, complete accessories	
Color chart	1
C. Welding	
Oxy-acetylene welding outfit, complete accessories	1 set
Electric-arc welding outfit, complete accessories	1 set
D. Woodworking	
Wood lathe, complete accessories	1
Grinder	1
Carpenter's tools, complete	1 set
Vises, rapid-acting	2
Saw	1 set
Portable sander	1
Band saw blade jointer	1
Wrenches, metric	1 set
Workbenches	2
Assorted saws	1 set
Hack saw (manual)	1
E. Machine Shop	
18" Metal lathe, complete accessories	1
Drill press	2
Workbenches	2
Machinist vises	1
Micrometers: outside, inside	2
Depth gauge	1
Machinist level	1
Combination square	1
Metal grinder	1
Tap and die	1 set
Drill bits	1 set
Calipers: outside, inside	2
Files, assorted	6
Cold chisels, assorted sizes	1 set
Reamers, assorted sizes	1 set
Steel ruler	1 pc.
Pipe threader	1
Pipe cutter	1
Pipe bender	1
Hack saw	1
Portable drill	1
Glass cutter	1
Sheetmetal cutter	2
Sheetmetal bender	1
Sheetmetal roller	1
Micro computer	10 units
Printer and other accessories	5 units
Air conditioner	2 unit
Needed software	1 set