DEVELOPMENT OF ENGINEERING EDUCATION AT BOGOR AGRICULTURAL UNIVERSITY, INDONESIA

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ABSTRACT

Engineering application and technology must be implemented to achieve modern and productive agriculture. In 1964, College of Agricultural Mechanization and Product Processing was established at Bogor Agricultutral University, consisting of two departments, one of which is the Department of Agricultural Mechanization. Later it was upgraded into Department of Agricultural Engineering, consisting of sub-departments: (1) Power and Farm Machinery, (2) Soil and Water Engineering, (3) Farm Structure and Environment, (4) Energy and Electrification, (5) Ergonomics and Instrumentation, and (6) Product Processing Engineering. The Department of Agricultural Engineering serves agricultural engineering courses for (1) Diploma Programs, (2) Bachelor Programs and (3) Graduate Programs. Student for Diploma Program and Bachelor Program are graduates from Senior High Schools, but some of them from Technical and Agricultural Vocational Schools. Student for Graduate Program mainly graduates from universities all over Indonesia, there are also graduates from universities in the developing countries such as Africa and Cambodia, as well as from developed countries such as Netherlands and Japan. There are 65 staffs available for teaching agricultural engineering courses in the Diploma, Bachelor and Graduate Programs. The facilities include classrooms, laboratories, workshop, and experimental field, which are equipped with modern equipments and instruments. Closely link to the Department of Agricultural Engineering, is the Center for Research and Engineering Apllication in Tropical Agriculture (CREATA), a research institution, which focus the activities in agricultural engineering, supported by 30 research staffs and technicians. Through CREATA, regional and international cooperation in graduate study and research program had been established, particularly with Japan institution and universities. In the near future, the Department of Agricultural Engineering will be enlarged and enhanced into a College of Agricultural Engineering and at present is under evaluation by a team from the Ministry for National Education.

I. INTRODUCTION

Engineering application and agricultural technology must be implemented to achieve modern and more productive agriculture. In Bogor Agricultural University, engineering education in agriculture in the field of Farm Mechanization had been started since 1963 at the Department of Agronomy, College of Agriculture. At that time, Farm Mechanization subject was sub-divided into five specialization, namely: Farm Power and Machinery, Soil and Water Engineering, Farm Structure and Building, Rural Electrification and Agricultural Product Processing.

In 1964, **College of Agricultural Mechanization and Product Technology** was established as the sixth college under the Bogor Agricultural University. Bilateral Cooperation was established with Kentucky Research Foundation and Midwest Universties Consorsium, USA. Staff members attended graduate courses in US and American Professors help in the upgrading of Agricultural Engineering Department. Cooperation is continued with Japan Institutions and Universities in education and research. Within the College of Agricultural Mechanization and Product Processing, there were two departments, namely **Department of Agricultural Mechanization** and Department of Agricultural Product Processing. The College was then enlarged by the addition of Agricultural Industry Department.

In 1990, the **Department of Agricultural Mechanization** was upgraded into a more broader and comprehensive field of study and become the **Department of Agricultural Engineering** consisting Sub-department of Soil and Water Engineering, Power and Farm Machineries, Energy

and Rural Electrification, Farm Structure and Environmental Engineering, Ergonomics and Instrumentation, Product Processing Engineering, and Farm Mechanization System. In the near future the Department of Agricultural Engineering will be enlarged and upgraded into **College of Agricultural Engineering**, consisting of Agricultural Civil Engineering, Agricultural Machinery Engineering, Biological Engineering, Agricultural Mechanization System, and Farm Structure and Environment Engineering. In the process of preparation for the enlargement and upgrading, new agricultural engineering curricula had been formulated, and the Department of Agricultural Engineering is now under a process of evaluation by the Accreditation Team from the Directorate General of Higher Education, Ministry of National Education.

Engineering education in agriculture are also offered for students at the University of Gajah Mada in Yogyakarta, University of Padjadjaran in Bandung, University of North Sumatera in Medan, University of Andalas in Padang, and University of Brawijaya in Malang and University of Hasanuddin in Makasar. At Bogor Agricultural University and the University of Gajah Mada, the Department of Agricultural Engineering is under the College of Agricultural Technology, while at the other Universities, as a sub-department under the Department of Agricultural Technology such as in the University of Padjadjaran and University of Brawijaya, or under the Department of Agronomy.

The Department of Agricultural Engineering serves courses for three level of study programs, namely (1) Diploma Program, (2) Bachelor Program (Ir), and (3) Graduate Program (MS, and Dr). The Diploma Programs cover 112 - 122 Semester Credit Unit in 3 year period, Bachelor Program 148-150 Semester Credit Unit in 4 year period, and the Graduate Program covers approximately 80 Semester Credit Unit for Master Program in 2 – 3 year period and 120 Semester Credit Unit for Doctor Program in 3 – 5 year period.

The Department of Agricultural Engineering also provide service course for students from other Departments within the same college, such Department of Agricultural Industry and Department of Food Technology, as well as students from other colleges, such as College of Agriculture, College of Animal Husbandry and College of Fisheries.

II. DIPLOMA PROGRAMS

2.1. Diploma Program in Soil and Water Engineering.

The Diploma Program in Soil and Water Engineering was established in 1997 and is now in the beginning of the fourth year. The curricula of the Diploma Program in Soil and Water Engineering consist of 45 courses including Field Works and Seminar, which in total cover 122 Semester Credit Units. The courses are divided into 6 semesters as presented in the Table 1.

The student enrollment for the Diploma Program in Soil and Water Engineering vary within a number of 20 – 30 students with ratio of male and female student approximately 2 : 1. Most of the students are graduates from Senior High School, and some of them are graduates from Technical Vocational School and Agricultural Vocational School. There are 20 staff members available for teaching at the Diploma Program in Soil and Water Engineering. Several qualified technicians are also available for the practical works.

Facilities for the Diploma Program include classroom, soil laboratories, hydraulics laboratory, irrigation and drainage equipments, and experimental field. Technical works and field works for the students in Semester 4 and Semester 6 are carried out in plantation, factory, transmigration project area and related development projects throughout Indonesia. However due to financial limitation and transportation constraint, the technical works and field works are mainly implemented in Java islands and the adjacent areas. First batch of graduates consisting of 22 students from the Diploma Program in Soil and Water Engineering will be inaugurated in September 2000

TABEL 1. CURRICULA FOR THE DIPLOMA PROGRAM IN SOIL AND WATER ENGINEERING

Courses	Credit	Courses	Credit
Semester 1		**Semester 2**	
Religion	2(2-0)	Mathematics/Statistics	2(2-0)
Philosophy	2(2-0)	Water Chemistry	2(1-3)
Indonesian Language	2(2-0)	Computer Application	2(1-3)
English Language	3(2-3)	Hydrometric	3(1-5)
Soil Physics/Mechanics	3(1-5)	Motor and Instrument	3(1-5)
Topographic Mapping	3(1-5)	Water Pump	3(1-5)
Hydraulics	3(1-5)	Surface Irrigation	3(1-5)
Technical Drawing	3(1-5)	Environment Management	3(2-3)
Total	**21**	**Total**	**21**
Semester 3		**Semester 4**	
Agric. Production System	3(2-3)	Watershed Management	3(2-3)
Green House/Hydro Phonic	3(1-5)	Engineering Economics	2(1-3)
Paddy Field Construction	3(1-5)	Report Writing	1(0-3)
Farm Power and Machinery	3(1-5)	Project Management	2(2-0)
Sprinkler and Drip Irrigation	3(1-5)	Technical Work	9(0-27)
Pollution Control	3(1-5)		
Groundwater Development	3(2-3)		
Total	**21**	**Total**	**17**
Semester 5		**Semester 6**	
Kewiraan	2(2-0)	Farm Management	3(2-3)
Building Construction	3(1-5)	Entrepreneurship	2(1-3)
Basic GIS Technique	2(1-3)	Resources Management	3(2-3)
Software Application	3(2-3)	Field Work	9(0-27)
Water Supply Engineering	3(1-5)	Scientific Report	2(0-2)
Information Management	2(1-3)	Seminar	1(1-0)
Drainage Engineering	3(1-5)	Final Examination	1(0-1)
Soil and Water Conservation	3(1-5)		
Total	**21**	**Total**	**21**
Grand Total			**122**

2.2. Diploma Program in Farm Mechanization

The Diploma Program in Farm Mechanization was established in 1996 and is now in the beginning of the fifth year. The curricula of the Diploma Program in Farm Mechanization consist of 40 courses including Field Works and Seminar, which in total cover 118 Semester Credit Units. The courses are divided into 6 semesters as presented in the Table 2.

The student enrollment for the Diploma Program in Farm Mechanization varies within a number of 30 – 40 students, which mainly consist of male students. Most of the students are graduates from Senior High School and some of them are graduates from Technical Vocational School and Agricultural Vocational School throughout Indonesia. There are 22 staff members available for teaching at the Diploma Program in Farm Mechanization. Several qualified technicians are also available for practical works.

Facilities for the Diploma Program in Farm Mechanization include classroom, mechanical laboratory, farm machinery equipments and experimental field. Field works for the students in Semester 3, Semester 4 and Semester 6 are carried out in factories, estate or plantation, transmigration project area and related development projects through out Indonesia. However, due to financial limitation and transportation constraint, mainly implemented in Java islands and the nearby areas. The second batch of graduates from the Diploma Program in Farm Mechanization will be inaugurated in September 2000.

2.3. Diploma Program in Instrumentation and Control.

The Diploma Program in Instrumentation and Control was established in 1996 and is now in the beginning of the fifth year. The curricula of the Diploma Program in Instrumentation and Control consist of 35 courses including Field Works and Seminar, which in total cover 112 Semester Credit Units. The courses are divided into 6 semesters as presented in the Table 3.

TABLE 2. CURRICULA FOR DIPLOMA PROGRAM IN FARM MECHANIZATION

Courses	Credit	Courses	Credit
Semester 1		**Semester 2**	
Basic Physics	3(2-3)	Philosophy	2(2-0)
Mathematics/Statistics	3(2-3)	Religion	2(2-0)
Electric Motor	3(1-4)	*Kewiraan*	2(2-0)
English Language	2(2-0)	Agricultural Tractors (2)	3(1-4)
Technical Drawing	2(1-3)	Workshop (1)	4(1-6)
Agricultural Tractors (1)	3(1-4)	Engineering Economics	3(1-4)
Agricultural Machinery (1)	4(1-6)	Agricultural Machinery (2)	4(1-6)
Total	**20**	**Total**	**20**
Semester 3		**Semester 4**	
Workshop (2)	4(1-6)	Sprinkler and Drip Irrigation	3(1-4)
Report Writing	2(2-0)	Machinery Services	3(2-3)
Agricultural Machinery (3)	4(1-6)	Instrumentation and Control	3(1-4)
Pumps and Blower	3(1-4)	Post harvest Machinery (1)	3(1-4)
Agric. Product Processing	3(1-4)	Machinery Management (2)	3(1-4)
Machinery Management	3(1-4)	Field Work (2)	4(0-12)
Field Work (1)	4(0-12)		
Total	**23**	**Total**	**22**
Semester 5		**Semester 6**	
Work Safety	2(2-0)	Farm Management	3(2-3)
Construction Materials	4(2-5)	Design of Farm Machinery	3(1-4)
Crop Production	3(1-4)	Green House Technology	3(1-4)
Crop Product Storage	3(1-4)	Land - Water Resources	3(2-3)
Post Harvest Machineries (2)	3(1-4)	Field Work (3)	4(0-12)
Entrepreneurship	2(-2-0)		
Total	**17**	**Total**	**16**
Grand Total			**118**

TABLE 3. CURRICULA FOR DIPLOMA PROGRAM IN INSTRUMENTATION AND CONTROL

Course	Credit	Course	Credit
Semester 1		**Semester 2**	
Basic Mathematics	3(2-3)	Religion	2(2-0)
Basic Physics	3(2-3)	Electrical Network	3(2-3)
Computer System	3(2-3)	Electronics (2)	3(1-6)
Work Safety	2(2-0)	Computer Application	3(1-6)
Electrical Instrument	3(1-6)	Digital Technique	3(2-3)
Electronics (1)	3(2-3)	Computer Programming	3(1-6)
Instrumentation (1)	4(2-6)	Equipment Construction	3(1-6)
Total	**21**	**Total**	**20**
Semester 3		**Semester 4**	
Magnetic Technique	3(2-3)	Philosophy	2(2-0)
Engineering Economics	3(2-3)	Introduction to Agriculture Engineering	2(2-0)
Micro-processor	3(1-6)	Instrument Maintenance	3(2-3)
Instrumentation (2)	3(1-6)	Automatic Control Application	4(2-6)
Control Technique	4(2-6)	Micro-computer Interfacing	4(2-6)
Electrical equipments	3(2-3)	Equipment/Instrument Construction	4(0-12)
		Field Work	4(0-12)
Total	**19**	**Total**	**23**
Semester 5		**Semester 6**	
Kewiraan	2(2-0)	Scientific Presentation	1(1-0)
English Language	3(2-3)	Final Task/Job Training	7(0-21)
Computer based instrument	4(2-6)		
Minimum System Hardware	4(2-6)		
Minimum System Software	4(2-6)		
Artificial Intelligence Application	4(2-6)		
Total	**21**	**Total**	**8**
Grand Total			**112**

The student enrollment for the Diploma Program in Instrumentation and Control vary within a number of 30 – 45 students and mainly consist of male students. Most of the students are graduates from Senior High School and some of them are graduates from Technical Vocational School and Agricultural Vocational School throughout Indonesia. There are 18 staff members available for teaching at the Diploma Program in Instrumentation and Control. Several qualified technicians are also available for the practical works.

Facilities for the Diploma Program in Instrumentation and Control include class room, mechanical and instrumentation laboratories and workshop. Field works and job training for the students in Semester 4 and Semester 6 are carried out in factories, research institutions and related development projects through out Indonesia. However, due to financial limitation and transportation constraint, mainly implemented in Java island and the nearby areas. The second batch of graduates from the Diploma Program in Instrumentation and Control will be inaugurated in September 2000.

III. BACHELOR PROGRAM

3.1. Curricula for Bachelor Program

The curricula for engineering education in the Department of Agricultural Engineering for the Bachelor Program (Ir) is the main curricula and cover 148 to150 Semester Credit Unit, which is spread into 8 (eight) semesters, each consisting of 18 to 22 Semester Credit Unit. The engineering courses represent 30 – 40 % percent of the total courses, and the remaining are basic courses, agricultural courses and general courses. Normally, it takes 4 (four) years for normal student to complete the undergraduate study.

For the first and second semester, the students are attending basic courses, such as Mathematics, Physics, Chemistry, Biology and general courses such as Religion, Philosophy, Indonesian and English languages, Culture and Sports. Some of these courses are jointly offered by the College of Agricultural Technology and some other courses are organized by Bogor Agricultural University, which are attended together with students from other fields of study in the same college or together with students from other colleges as well.

Starting from Semester 3, the agricultural engineering students attend special courses offered by the Department of Agricultural Engineering and in Semester 5 and Semester 6 the curricula is specialized into the Pre-harvest and Post-harvest fields of study The current curricula served by the Department of Agricultural Engineering for the Bachelor Program is presented in the Table 4 and Table 5.

In 1996, the curricula for the served by the Department of Agricultural Engineering for the Bachelor Program was improved by adding two courses namely Sport and Culture and Entrepreneurship.

TABLE 4. CURRICULA FOR SEMESTER 1–2 IN THE BACHELOR PROGRAM

Semester 1	Credit	Semester 2	Credit
General Biology	3(3-0)	General Chemistry	3(2-3)
Basic Mathematics	3(3-0)	Basic Biology	3(2-3)
Introduction to Agriculture	1(1-0)	General Economics	3(3-0)
Indonesian Philosophy	2(2-0)	Religion	2(2-0)
Kewiraan	2(2-0)	Calculus 1	3(3-0)
General Physics	3(2-3)	General Sociology	3(3-0)
Indonesia Language	2(2-0)		
English Language	3(3-0)		
Total	**19**	**Total**	**18**

TABLE 5. CURRICULA FOR SEMESTER 3–8 IN THE BACHELOR PROGRAM

Course	Credit	Course	Credit
Semester 3		**Semester 4**	
Calculus	3(3-0)	Engineering Mathematics	3(3-0)
Introduction to AE	3(3-0)	Thermodynamics	4(4-0)
Static and Dynamics	3(2-3)	Statistical Methods	3(3-0)
Fluid Mechanics	3(2-3)	Engineering Drawing	3(2-3)
Machine Shopwork	3(2-4)	Farm Surveying	2(2-4)
General Climatology	3(3-0)	Construction Materials (T)	3(2-0)
Computer Application	3(2-3)	Environment Measurement	3(2-3)
Total	**21**	**Total**	**21**
Semester 5		**Semester 6**	
Construction Material (P)	1(0-3)	Engineering Mechanics	3(3-0)
Strength of Materials	3(2-3)	Engineering Economics	3(3-0)
Farm Power	3(2-3)	System Analysis (1)	3(3-0)
Hydrology	3(3-0)	Energy and Electrification	3(2-3)
Management	3(3-0)	Field Work/Study	6-7
Compulsory Courses		**Compulsory Courses**	
Pre-harvest group :		**Pre-harvest group :**	
Soil Sciences	3(3-0)	Farm Power Analysis	3(2-3)
Agronomy	4(3-3)	Soil, Water and Plant	3(2-3)
		Soil & Water Conservation	3(2-3)
Post-harvest Group :		**Post-harvest Group :**	
Food Preservation Eng.	3(3-0)	Food Process Engineering	4)3-3)
Material Handling	3(2-3)	Agriculture Product Process Eng.	3(2-3)
		Structure & Environment	3(3-0)
Total	**19-20**	**Total**	**24-25**
Semester 7		**Semester 8**	
Engineering Design	3(3-0)	Special Problem/Research	6(0-24)
Capita Selecta Courses *)	15		
Seminar	2(2-0)		
Agribusiness	2(2-0)		
Total	**22**	**Total**	**6**
Grand Total			**71-73**
***) Elective Courses**	**Credit**	***) Elective Courses**	**Credit**
Power & Farm Machinery	3(2-3)	Machinery Management	3(3-0)
Product Process Eng.	3(2-3)	Mechanization Management	3(3-0)
Ergonomics	3(2-3)	Computer Application	3(2-3)
Soil-water and Machinery	3(2-3)	Artificial Intelligence	3(2-3)
Land Clearing	3(2-3)	Information System	3(2-3)
Design of Machinery	3(2-3)	Food Process Engineering	3(3-0)
Agricultural Tractor	3(2-3)	Agric. Product Process Eng.	3(3-0)
Irrigation Engineering	3(2-3)	Cold Storage	3(2-3)
Drainage Engineering	3(2-3)	Alternative Energy	3(2-3)
Environment Analysis	3(2-4)	Rural Electrification	3(3-0)
Automatic Control	3(2-3)	Energy Utilization	3(3-0)
Design of Farm Structure	3(2-3)	Applied Mathematics	3(3-0)

3.2. Student, Staff Member and Facilities

The student enrollment for the Bachelor Program vary from year to year, however usually within the number of 150 to 200 students per year. Students of the Bachelor Program are mostly graduates from Senior High School, however there are also some graduates from Technical Vocational School and Agricultural Vocational School. There are 65 teaching staffs available for the Bachelor Program, consisting of Assistants, Lecturers and Professors. A number of qualified and experience technicians are available for the practical work activities (See Table 6).

TABLE 6. STAFF MEMBERS IN THE DEPARTMENT OF AGRICULTURAL ENGINEERING

Field of Specialization	Name	Degree
Agricultural Machinery Engineering	Frans Yusuf Daywin	Ir. M.Eng.
	Desrial	Ir. MSc. Dr.
	Imam Hidayat	Ir. M.Eng.
	Kusen Morgan	Ir. MS
	Gatot Pramutadi	Ir. MS
	E. Namaken Sembiring	Ir. MS. Dr.
	I. Nengah Suwastawa	Ir. MS.Dr.
	Agus Sutedjo	Ir. MS
	Faiz Syuaib	Ir.
	Mad Yamin	Ir. MS
	Sam Herodian	Ir. MS. Dr.
	Wawan Hermawan	Ir. MS. Dr.
	PAS Radite	Ir. MS. Dr.
Biology & Food Process Engineering	Kamaruddin Abdulah	Dr.Prof.
	Sri Endah Agustina	Ir,MS
	Usman Ahmad	Ir.Ms.Dr.
	I.Wayan Budiastra	Ir.MS.Dr
	Edy Hartulistiyoso	Ir.MS.Dr.
	Abdul Kohar Irwanto	Ir.Ms.Dr.
	Putiati Mahdar	Ir.MS.Dr.
	Moedjiarto Pratomo	Ir.MSc.
	Hadi Karya Purwadaria	Ir.MSc.Dr.Prof
	Aris Purwanto	Ir.MSc.Dr.
	I Dewa Made Subrata	Ir.MS.Dr.
	Suroso	Ir.MS.Dr
	Sutrisno	Ir.MS.Dr.
	Atjeng Muchlis Syarief	Ir.MS.Dr.
	Armansyah Tambunan	Ir.MS.Dr.
	Dyah Wulandari	Ir.MS
Soil & Water Engineering	Moh. Azron Dhalhar	Ir.MSc.Dr.
	Erizal	Ir.MSc.Dr.
	Soedodo Hardjoamidjoyo	Ir.MSc.Dr.Prof.
	Nora Haris Panjaitan	Ir.DEA.Dr.
	Dedi Kusnadi Kalsim	Ir.MEng.DipHE
	Prastowo	Ir.MEng.
	Moh.Yanuar Purwanto	Ir.MS
	Roh Santoso Budi Utomo	Ir.MS
	Asep Sapei	Ir.MS.Dr
	Budi Indra Setiawan	Ir.MAgr.Dr.
	Yuli Suharnoto	Ir.MSc.Dr.
	Sukandi Sukartaatmadja	Ir.MS
Agrosystem and Information	I Wayan Astika	Ir.MS.Dr.
	Emmy Darmawati	Ir.MS
	Mulyarno Djojomartono	MA.Dr.
	Setyo Pertiwi	Ir.MS.Dr.
	Bambang Pramudya	Ir.MS.Dr.Prof.
	Kudang Boro Seminar	Ir.MSc.Dr.
	Moh. Solahuddin	Ir.MS
Farm Structure & Environment	Gardjito	Ir.MSc.
	Rokhani Hasbullah	Ir.MSc.
	Sri Mudiastuti	Ir.MEng.
	Lilik Pudjiantoro	Ir.MAgr.Dr.
	Hery Suhardiyanto	Ir.MAgr.Dr.
	Meiske Widyarti	Ir.MS.
	Arif Sabdo Yuwono	Ir.MS.

IV. GRADUATE PROGRAM

4.1. Classification of Graduate Program

Formerly there are two Graduate Program served by the Department of Agricultural Engineering, namely Graduate Program of Agricultural Engineering in a broad sense, and Graduate Program of Post-harvest Engineering, which is more specialized in post-harvest

handling field of study. Both Graduate Programs may have some similar courses and certainly more different courses. Each of the Graduate Program consist of Master Program and Doctor Program.

At present, the Graduate Program in the Department of Agricultural Engineering consist of 4 (four) sub-program, namely: (1) Agricultural Machinery Engineering; (2) Biology and Food Process Engineering; (3) Soil and Water Resources Engineering,; and (4) Agro-system and Information.. At Bogor Agricultural University, there are 33 Graduate Programs with 300 to 500 students enrollment during the period of 1993 – 1998. The average percent of student acceptance is 66.5 %. For Agricultural Engineering Graduate Program, the figure is 5 to10 students with an average percent of acceptance 66.7 %.

4.2. Curricula of the Graduate Program

The curricula for Graduate Programs, which consist of Master and Doctor Program in the Department of Agricultural Engineering are presented in the Tables 7 and Table 8.

TABLE 7. THE GENERAL CURRICULA OF MASTER PROGRAM IN AGRICULTURAL ENGINEERING

Course	Credit	Course	Credit
Semester 1		**Semester 2**	
English for Research	3	Applied Mathematics	3
Statistical Analysis	3	Research Method	3
Instrumentation	3	Kinematics and dynamics	3
Computer Programming	3	Advanced Food Processing	3
		Soil Physics and Mechanics	3
		System Analysis	3
		Elective	3-6
Total	**12**	**Total**	**21-24**
Semester 3		**Semester 4**	
Colloqium	1	Seminar	1
Agricultural Machinery	3	Research and Thesis	6
Advanced Product Processing	3		
Biological Process	3		
Advanced Hydraulics	3		
Decision Making Process	3		
Elective	3-6		
Total	**19**	**Total**	**7**
Grand Total			**41 (min)**

TABLE 8. THE GENERAL CURRICULA FOR DOCTOR PROGRAM IN AGRICULTURAL ENGINEERING

Compulsory Course	Credit	Elective Course	Credit
English language	3		18 - 37
Colloqium	1		
Science Philosophy	2		
Seminar	1		
Research and Desertation	12		
Total	**17**		**18 - 37**
Grand Total			**34 - 53**

4.3. Student and Staff Member

Student enrollment for the Graduate Program come from Bogor Agricultural University and many other Universities in Indonesia as well as from the developing countries in Asia, such as Thailand and Cambodia. Several graduate students come from developed countries such as Netherlands and Japan. The student enrollment is in the range of 6 - 13 students for both the Master and Doctor Programs. Student enrollment at the Graduate Programs is presented in the Table 9.

TABLE 9. GRADUATE STUDENT ENROLLMENT IN THE DEPT. OF AGRICULTURAL ENGINEERING

Master Program	1993	1994	1995	1996	1997	1998
Enlisted	5	10	9	7	10	13
Accepted	5	4	6	3	8	10
Percentage	100	40	67	43	80	77
Doctor Program						
Enlisted	2	3	8	5	4	3
Accepted	1	1	6	5	2	3
Percentage	50	33	75	10	50	100

Staff member consist of alumnus from University of Indonesia, Bandung Institute of Technology, Bogor Agricultural University and University of Gajah Mada, as well as from foreign universities in the USA, Canada, Germany, France, Belgium, Japan, Australia, Thailand and Philippines. The teaching staffs available for the Graduate Program are presented in the Table 10.

TABLE 10. NUMBER AND DEGREE OF THE TEACHING STAFF IN THE GRADUATE PROGRAM

University Degree	Number (person)	Remarks
Master (MS. MSc. MEng. MAgr. DEA)	26	
Doctor (Doctor, Ph.D)	24	4 Professors
Total	50	

V. RESEARCH INSTITUTION

Closely link to the Department of Agricultural Engineering, a Research Unit called CREATA (Center for Research and Engineering Application in Tropical Agriculture) was established in 1994, representing one among several Research Institutions in Bogor Agricultural University. A total of 35 research staffs varying in rank from Assistant Researcher to Professor are available for research works and related scientific activities. Research facilities include machinery laboratory, hydraulic laboratory, energy laboratory, farm structure laboratory, product processing laboratory, computer laboratory, all equipped with modern instruments. There are experimental field, construction workshop, and pilot plant. All of the facilities are housed in a four stories building, constructed in 1990 and equipped with communication system and other facilities. The building was built as a grant from the Government of Japan through the Japan International Cooperation Agency (JICA) in cooperation with the Ministry of Education of Indonesia.

The vision of CREATA is to become a leading center for the development and application of engineering approaches to create technology for the development of sustainable tropical agriculture. The mission is to develop appropriate technologies necessary to create optimum and environmentally sound agricultural production systems supported by the necessary rural infrastructure that could help in developing modern, industrialized and sustainable agriculture through basic and applied research.

The objective are; (1) to obtain and disseminate appropriate technologies for developing modern, industrialized and sustainable agriculture in the tropics, (2) to obtain and provide facilities for graduate teaching and research at Bogor Agricultural University staffs, particularly in the field of Agricultural Engineering, (3) to provide conducive environment and facilities for the graduate training of high quality agricultural engineering manpower in order to increase their capability in research, planning, management, entrepreneurship, and competence in design and testing of equipment, consultancy activities, dissemination of information on new development in science and technology relevant to agricultural development. Through CREATA, training and research programs have been conducted in cooperation with various regional and international institutions and universities.

VI. DEVELOPMENT

In the near future, the Department of Agricultural Engineering, will be enlarged and upgraded to become a College of Engineering, which will provide curricula and serve courses in at least four engineering field of studies. Those four engineering field of studies are: (1) Agricultural Mechanical Engineering, (2) Agricultural Civil Engineering, (3) Biological and Food Process Engineering, and (4) Agro-system and Information. The Department of Agricultural Engineering should be able to accommodate more students which are interested in agricultural engineering field of study, and eventually to provide sufficient number of qualified graduates in agricultural engineering through the Diploma, Bachelor, Master and Doctor Programs, to meet the need for qualified and competent human resources in agricultural development.

Support from the Directorate General of Higher Education, Department of National Education and related regional and international institutions, is urgently required, as well as professional associations, industries and private sectors related to engineering education in agriculture. In line with the privatization program for Bogor Agricultural University and other prominent universities in Indonesia, the future development Agricultural Engineering Department at Bogor Agricultural University will play an important role in the enhancement of engineering education.

REFERENCES

[1] Anonymous, *Academic Development of The Graduate Program at Bogor,* Agricultural University. Bogor, 1991.
[2] Anonim, *Penjelasan Kurikulum Program Studi Teknik Pertanian.* (Pedoman bagi Dosen dan Mahasiswa), Fateta, IPB. Bogor 1999.
[3] Anonim, *Usulan Akreditasi Program Diploma Manajer Alat dan Mesin Pertanian,* Fateta, IPB. Bogor 1999.
[4] Anonim, *Program Diploma Teknik Pendayagunaan Lahan dan Air*, Fateta, IPB, Bogor 2000.
[5] Anonim, *Program Diploma Instrumentasi dan Kontrol,* Fateta, IPB, Bogor 2000.
[6] Illah Sailah, Fakultas Teknik, Institut Pertanian Bogor, *Jajak Pendapat,* IPB Bogor ,2000.
[7] Jun Sakai, *The Development of Agricultural Engineering Education in Japan. Kyushu University – Bogor Agricultural University,* 1997.
[8] Kamaruddin Abdulah, "Profile CREATA", *Center for Research and Engineering Application in Tropical Agriculture*, IPB, Bogor, 2000.
[9] Moh. Azron Dhalhar, *Program Studi Ilmu Keteknikan Pertanian, Dulu, Kini dan Nanti.* Fateta, IPB Bogor, 2000.
[10] Moh. Azron Dhalhar, *Program Studi Ilmu Keteknikan Pertanian,* Jurusan Teknik Pertanian, Fateta, IPB. Bogor 2000.
[11] Stout, B.A. "Agricultural Trends and Their Effects on Technological Needs for Farm Equipment in the 21 Century", *Dept. of Agricultural Engineering.* Texas A & M University, Texas, USA. 1997.
[12] Stout, B.A. "Trends in Agricultural Engineering Education and Research in the United States", *Implication for Indonesia.* CREATA, BAU. Bogor 1997