

National Academic Reference Standards (NARS)

Agriculture

January 2009

1st Edition

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Preface

Based on the Presidential Decree number (82) for the year 2006, the National Authority for Quality Assurance and Accreditation of Education (NAQAAE) was founded to enhance the quality of education in Egypt.

In the light of NAQAAE's mandates, developing National Academic Reference Standards (NARS) for higher education comes on the top of its priorities. NARS are intended to set out clearly the graduate attributes and academic characteristics expected to be achieved in the academic programs of different disciplines.

The natural resources are no longer the backbone for development and prosperity; instead knowledge economy has become the main base for inducing tremendous and progressive breakthroughs in the resources of nations. In this regard, knowledge economy requires high quality education based on well defined reference standards.

The international changes and the concomitant alterations in the socio-economic conceptions obliged quality education as the main gate for human resources development. The latter, in turn, is counted as one of the most important determinants of national sustainable development.

Good practice in education should encourage students to improve their innovative and creative capabilities, employ appropriate technologies and pursue independent and life-long learning. This would necessitate setting out plans to develop the institutional capabilities and educational efficiency. Accordingly, educational

institutions have to reform their programs and courses to meet the demands of the labor market. In addition, graduates should acquire the flexibility that enables them to adapt to the future needs of the labor market.

In alignment with its functions, NAQAAE, in collaboration with the stakeholders, has developed an integrated system to assure education quality. One of the system's outcomes is a series of guides for NARS in different academic disciplines to help higher education institutions in designing their programs to meet the accreditation requirements.

*National Authority for
Quality Assurance and
Accreditation of Education (NAQAAE)*

Acknowledgements

The National Authority for Quality Assurance in Education, (NAQAAE) would like to thank all the stakeholders involved in this work. The stakeholders included are representatives from the Ministry of Higher Education, National Syndicates, the Academic university staff members and the Private Sector. All of them were committed to make this work possible through their knowledge and experience.

The President of the National Authority for Quality Assurance in Education, Professor Magdy Kassem and Board members would like to acknowledge the efforts done by the task force group assigned to prepare this guideline for their hard work to ensure high quality graduates and to be comparable to the international standards.

Professor Magdy Kassem
NAQAAE, President

Methodology

NAQAAE has invited a group of education experts, in different academic disciplines, from state, private and Al-Azhar Universities to develop a general framework of the guide for the national academic reference standards (NARS) in the different sectors of higher education. The steps proceeded as follows:

1. Brain Storming

The authority held several workshops for expert groups to discuss the general framework and elements/contents of the NARS guide and Standardization of concepts and terms used in the NARS within a definite time table.

2. Reviewing of the International Academic Standard

Experts groups have reviewed the academic standards of some World accreditation institutions and standard applied in the corresponding faculties at universities from different countries in the world to have access to the global level, taking into account the need to preserve the Egyptian identity.

3. Reviewing the Available Academic Standards in Egypt

The working groups have reviewed the academic standards which have been developed by the sectors of the Supreme Council of Universities - Ministry of Higher Education and Scientific Research. In accordance with the required amendments to NAQAAE, groups developed the guidelines to meet the needs of higher education institutions.

4. Reviewing by Technical Committee

Standard first drafts were reviewed by technical committees formed by NAQAAE board, to insure that standards meet the

agreed essential elements as well as the technical editing of the draft.

5. Stakeholders Approval

After the completion of the draft of national academic reference standards, it was presented to representatives from stakeholders, faculty members from different universities and Al-Azhar institutions and representatives from the Ministry of Higher Education and the State for Scientific Research, to take appropriate action.

6. Dissemination

The Authority posted academic standards on its website (naqaae.org.eg), to receive feedback from students, faculty members and stakeholders.

7. Endorsement of Standards

The draft was revised according to the feedback received and introduced to NAQAAE's Board for approval.

Introduction to Agriculture Education

Agriculture is an economic activity that provides the community with safe food and fiber. The agricultural programs are aiming at graduating professionals to fulfill the community needs in the sector of agri-business. This is in addition to strengthen the concepts of natural resources preservation as well as make emphasizes good agricultural practices and maintain the natural bio-diversity.

The agricultural programs are planned to allow students to complete their study within four years. Structure of the programs is designed as a combination of biology, mathematics, economics, sociology and other sciences related to agriculture. This academic reference structure is targeted to build-up the capacity of the graduates to integrate the principles of basic sciences to adopt and utilize the new concepts and technologies for sustainable agricultural development.

The B. Sc. in agriculture includes eight programs, each program may comprise one or more majors:

1. Plant production that serves the majors of agronomy and horticulture,
2. Animal production that serves the majors of livestock, poultry and fish production,
3. Food sciences include the sectors of dairy and food processing,
4. Plant protection
5. Biotechnology
6. Agricultural engineering
7. Agricultural socio- economic that services the majors of agriculture economics and agriculture extension

8. The soil and Water integrated management or Agriculture natural resources management and Environment

The NARS of these programs are based on the national requirements and international standards. The NARS allow flexibility for the academic programs to adopt new techniques and technologies in the light of the international progress and profession development. The NARS also give a special attention to the skills of self-management and evaluation, self-learning, communication, language and leadership skills.

Graduates of these programs have job opportunity in a wide range of agricultural firms: Agro-industries, commercial trading, mass media, rural development, human nutrition, analytical laboratories, pharmaceutical firms, technical sales, quality control and research stations, educational institutions and agricultural ecommerce organization.

I. National Academic Reference Standards

1. General Academic Reference Standards

1.1. General Attributes of Agriculture Graduates

Graduate of agriculture must be able to:

- 1.1.1. Recognize the role of agriculturalists in the society
- 1.1.2. Manage and utilize agricultural resources appropriately
- 1.1.3. Participate in managing agricultural business
- 1.1.4. Display appropriate professional commitment and attitudes
- 1.1.5. Conserve natural resources and maintain bio- diversity
- 1.1.6. Demonstrate awareness of relevant legal, ethical, and socio-economic issues,
- 1.1.7. Be prepared for self-management and continuous learning
- 1.1.8. Be prepared to engage in research studies

1.2. Knowledge and Understanding

Graduate of agriculture must acquire the following knowledge and understanding:

- 1.2.1. The basic and applied sciences related to agriculture
- 1.2.2. The terminologies in agriculture used in farming communities areas
- 1.2.3. Quality management concepts
- 1.2.4. Risk factors in agriculture and how to deal with it
- 1.2.5. Methods of handling and recycling agricultural wastes

- 1.2.6. Basics of planning for agricultural business
- 1.2.7. Basics of micro- economics, macroeconomics, and international economics.
- 1.2.8. Scio- economic aspects related to sustainable agriculture
- 1.2.9. Bio-safety regulations and practices in agriculture
- 1.2.10. Concepts of bio-diversity and maintaining natural resources
- 1.2.11. Agricultural legislations and ethics related to environment and human-being health
- 1.2.12. Basics of information economy and experimental economics

1.3. Practical Skills

Graduates of Agricultural Program must be able to:

- 1.3.1 Apply good practices in agriculture that increase and improve agro-products
- 1.3.2. Produce safe food and fiber considering environmental issues
- 1.3.3. Use of agricultural recourses for sustainable agriculture
- 1.3.4. Prepare preliminary accounting records for agricultural projects
- 1.3.5. Plan according to changes in national and international economics
- 1.3.6. Prioritize developmental issues related to rural community and urban areas
- 1.3.7. Perform agricultural extension plans and programs
- 1.3.8. Plan and conduct an independent investigation with limited guidance.

1.4. Intellectual Skills

Graduates of Agricultural Program must be able to:

- 1.4.1. Observe, collect, and analyze data to solve agricultural problem
- 1.4.2. Design and conduct experiments and draw conclusions
- 1.4.3. Integrate some lines of evidence to elucidate phenomenon and assess risks
- 1.4.4. Choose the best among alternatives to maximize benefits

1.5. General Skills

Graduates of Agricultural program must be able to:

- 1.5.1. Present information and interpret phenomena verbally by report writing
- 1.5.2. Show satisfactory English language
- 1.5.3. Use appropriate audiovisual aids in a presentation
- 1.5.4. Work in a team and understand group behavior
- 1.5.5. Demonstrate basic management capabilities
- 1.5.6. Use software packages in variety of agricultural activities
- 1.5.7. Use information technology for trade and communication
- 1.5.8. Demonstrate self and long life learning
- 1.5.9. Exhibit satisfactory leadership ability

2. National Academic Reference Standards for Plant Production Program

The NARS of this program cover the major fields of vegetable, pomology and ornamental agriculture crops. In addition to basic and related sciences, plant breeding, soil and water, economics, plant pathology, plant protection, sociology and agricultural engineering sciences are required to fulfill the graduate attributes of this program.

Career opportunities for the graduates in this program include agri-business firms, seed and seedling productions, biotechnology laboratories, and stations of grading, evaluating and packing, research stations and agriculture extension centers.

2.1. Attributes of plant production graduates

Graduates of plant production program must be able to:

- 2.1.1 Suggest plans of cultivation based on soil and water types and quality.
- 2.1.2. Use water and soil resources efficiently
- 2.1.3. Practice agriculture under different production and ecological systems.
- 2.1.4. Minimize post harvest loss.

2.2. Knowledge and Understanding

Graduates of plant production program must acquire the following knowledge and understanding:

- 2.2.1. Morphology, anatomy and histology of kingdom planta
- 2.2.2. Requirements for optimal growth and production of major crops

- 2.2.3. Crop production systems in relation to ecological matrix
- 2.2.4. Soil management and practice of soil conservation and maintenance
- 2.2.5. Principles of using fertilizers and fertilizer requirements of major crops
- 2.2.6. Water requirement of major crops and irrigation / drainage systems
- 2.2.7. Principles of agriculture machinery and applications in agricultural practices
- 2.2.8. Basics of weed and pest control and plant pathogens
- 2.2.9. Pre and post-harvest good practices for different crops.
- 2.2.10. Crops import and export regulations and legislations

2.3. Practical Skills

Graduates of Plant Production Program must be able to:

- 2.3.1. Grow and propagate major crops
- 2.3.2. Calculate and apply appropriate fertilizers
- 2.3.3. Calculate water requirements for certain crop and apply appropriate irrigation system
- 2.3.4. Calculate and apply appropriate pesticides and herbicides
- 2.3.5. Harvest major crops appropriately

- 2.3.6. Manage post harvest processes of major crops
- 2.3.7. Identify key fungal, viral and bacterial problems, to assess risks and suggest the appropriate control methods
- 2.3.8. Select and breed high quality crops
- 2.3.9. Use tissue culture for vegetative propagation
- 2.3.10. Design an appropriate crop rotation for field/ green houses
- 2.3.11. Calculate cost of production for specific crop
- 2.3.12. Practice integrated pest management
- 2.3.13. Select appropriate crops relative to ecological matrix, water and soil quality
- 2.3.14. Use appropriate agro machines
- 2.3.15. Apply the general field/green houses agricultural practices

2.3.A. Additional practical skills related to Ornamental agriculture option

- 2.3.A.1. Design landscape for rural and urban areas
- 2.3.A.2. Maintain effective ingredients during harvesting and post-harvest of medicine plants
- 2.3.A.3. Apply effective extraction methods for medicine plants

2.3.B. Additional practical skills related to Pomology

option

2.3.B1. Establish new orchard

2.3.B.2. Apply methods for grow fruit-tree breeding
for maximum production

2.3.B.3. Select certain pollinators for high fruit
production

2.3.B.4. Apply methods to induce fruit maturation

2.3.C. Additional practical skills related to vegetable crops

option

2.3.C.1. Grow vegetables using different agricultural
systems

2.3.c.2. Increase vegetable shelve life

2.4. Intellectual Skills

Graduates of Plant Production Program must be able to:

2.4.1. Suggest plans for commercial plant production

2.4.2. Analyze and evaluate farm activities and plan
accordingly

3. National Academic Reference Standards for Animal Production

The NARS cover the requirements of knowledge and skills needed in animal and/or poultry production business. Sciences of genetics, bio-chemistry, animal health and diseases, economics, processing and handling of animal products, agronomy and agricultural mechanization as well as specialized sciences in breeding, physiology, nutrition, and production systems are required to build up the capacity of the graduates of this program.

Animal / poultry production business, artificial insemination firms, feed processing plants, biotechnology and feed analytical laboratories, feed trades and inspection, agricultural quarantine and research stations are the main career opportunities for graduates of this program.

3.1. Attributes of animal production graduates

- 3.1.1. Manage livestock / flocks under extensive and intensive systems
- 3.1.2. Integrate reproductive techniques in breeding plans and genetic resources conservation
- 3.1.3. Plan for genetic improvement considering the farm level
- 3.1.4. Produce high quality animal products
- 3.1.5. Integrate the concepts of animal nutrition in feeding practices.
- 3.1.6. Practice to prevent spreading of epidemic and endemic diseases.

3.2. Knowledge and understanding

Graduates of Animal Production must acquire the following knowledge and understanding:

- 3.2.1. The interdisciplinary sciences relevant to animal production.
- 3.2.2. The physiological basis of endocrinology, reproduction, digestion, growth, lactation, and adaptation
- 3.2.3. Major concepts of livestock production systems
- 3.2.4. Nutrients, nutritional requirements, feeding practices and major steps of feed processing
- 3.2.5. Theories of inheritance and methods for animal / poultry breeding.
- 3.2.6. Housing and managerial practices needed to overcome the adverse impact of micro- and macro-climates
- 3.2.7. Necessary procedures to prevent and control the epidemic, endemic and zoonotic diseases
- 3.2.8. Principles of animal/poultry transportation and product handling
- 3.2.9. The interaction between animals/ poultry and ecosystems
- 3.2.1.0. Feeding, reproduction, production and acclimatization behavior

3.3. Practical skill

The graduate of Animal Productions program must be able to:

- 3.3.1. Select quality livestock / poultry
- 3.3.2. Design and maintain livestock records to extract evidences and make decisions to improve productivity and health
- 3.3.3. Calculate livestock nutritional requirements according to age, productive and reproductive status
- 3.3.4. Formulate economic balanced ration
- 3.3.5. Identify infectious diseases and take the necessary actions to control disease spreading
- 3.3.6. Handle animals and their products properly
- 3.3.7. Apply the international standards for animal / poultry welfare
- 3.3.8. Calculate costs of production for livestock/ poultry farms

3.3.A. Additional skills related to poultry production option

- 3.3.A.1. Manage poultry farms
- 3.3.A.2. Grade / evaluate table and hatching eggs
- 3.3.A.3. Grade / evaluate poultry carcass
- 3.3.A.4. Manage hatcheries

3.3.B. Additional skills related to animal production option

- 3.3.B.1. Manage dairy, beef, and sheep farms
- 3.3.B.2. Operate and maintain machine milking appropriately
- 3.3.B.3. Practice calf rearing appropriately

- 3.3.B.4. Diagnose pregnancy
- 3.3.B.5. Grade / evaluate meat, carcass and wool
- 3.3.B.6. Choose the appropriate treatment to overcome low fertility of farm animals

3.3.C. Additional skills related to fish production option

- 3.3.C.1. Manage Fish farms
- 3.3.C.2 . Operate, maintain equipments and machinery used in fish farms
- 3.3.C.3. Judge fish quality
- 3.3.C.4. Establish and manage fish hatcheries

3.4. Intellectual skills

The graduates of Animal Production must be able to:

- 3.4.1. Interpret records to extract evidence
- 3.4.2. Draw preliminary breeding plan for genetic improvement
- 3.4.3. Discuss issues related to animal production based on scientific facts.

4. National Academic reference Standards for Plant Protection Program

The program of plant protection is a multidiscipline program based on the integration among economic entomology, plant pathology, zoology and pesticides sciences. This program integrates knowledge about biological and ecological aspects of pests with a wide variety of cultural, physical, biological and chemical approaches to find the most environmentally sensitive and economically feasible method of pest control. The NARS of this program make emphasis on the methods of prevent spreading, diagnose infection and treat the case of pest infection.

In addition to the field work of plant protection and pest control business, the career of this program is also extended to include agro-chemical industries, mass production of bio- control agents, honey bee production, trading pesticides, laboratories of pesticide residue analysis, and researches stations.

4.1. Attributes of graduates

The graduates of plant protection program must be able to:

- 4.1.1. Design plans for pest prevention.
- 4.1.2. Use efficiently the appropriate control method(s) considering the ecological aspects.
- 4.1.3. Plan and implement integrated pest management program.
- 4.1.4. Maintain pest damage below the economic injury level.
- 4.1.5. Assess hazards of pesticides on non-target organisms
- 4.1.6. Distinguish among the symptoms of different plant diseases

4.2. Knowledge and understanding

Graduates of plant protection program must acquire the following knowledge and understanding:

- 4.2.1. Basics of classification of pests and pathogens
- 4.2.2. Taxonomy, morphology, anatomy, and physiology of pests and their natural enemies and factors influencing their spreading.
- 4.2.3. Ecological factors that convert plant diseases to epidemic diseases
- 4.2.4. Classes of pesticides and their formulations, mode of action and hazard categories.
- 4.2.5. Principles of integrated pest management (IPM)
- 4.2.6. Basics of pest control biologically and chemically.
- 4.2.7. Good practices for handling, transferring, storing and application of pesticides,
- 4.2.8. Products of honey bees and silk worms
- 4.2.9. Effects of pests on plant and animal health
- 4.2.10. National and international safety standards related to pesticide residues in agricultural products.
- 4.2.11. International standards, legislations, registration and regulation related to trading, handling and usage of pesticides.

4.3. Practical Skills

The graduates of plant protection Program must be able to:

- 4.3.1. Estimate pest population size and the populations of their natural enemies.

- 4.3.2. Apply appropriate methods for biological control.
- 4.3.3. Identify pathogens and define management actions.
- 4.3.4. Determine pesticide residue in agricultural products and environment.
- 4.3.5. Analyze and manage the problem of pest resistance to pesticides and other control agents.
- 4.3.6. Manage apiaries.
- 4.3.7. Produce honey and control honey bees pest
- 4.3.8. Rear silk-worms and produce silk
- 4.3.9. Identify symptoms of pesticide poisoning and apply first aid measures
- 4.3.10. Test and evaluate quality of pesticide formulation

4.4. Intellectual skills

The graduates of plant protection Progrma must be able to:

- 4.4.1. Design programs for solving pest problems,
- 4.4.2. Plan preventive actions for plant protection
- 4.4.3. Design programs for control insects involved in plant diseases transmission

5. National Academic Reference Standards for Food Sciences

Food science program includes two majors; food processing and dairy technology. In addition to basic sciences related to agriculture program, microbiology, chemistry, human nutrition and engineering sciences are the cornerstones of this program.

Graduates of this program have the opportunities to work in food processing firms, quality control organizations, technical sales, research and development, food microbiologist, food standards officers, food technologists and in research centers.

5.1. Attribute of graduates

Graduates of Food Sciences program must be able to:

- 5.1.1. Process different food and related products.
- 5.1.2. Apply quality control and food safety standards.
- 5.1.3. Use the up-dated methods to evaluate food and related products.
- 5.1.4. Recognize the appropriate storage conditions for various food products.
- 5.1.5. Control food deterioration and spoilage.

5.2. Knowledge and understanding

Graduates of food sciences Program must acquire the following knowledge and understanding:

- 5.2.1. Physical properties and reactions of food components and how to control these reactions.

- 5.2.2. Traditional and non-traditional methods for food processing and preservation
- 5.2.3. Important pathogens and spoilage microorganisms in foods and how to control their growth
- 5.2.4. Concepts of total quality management in industrial firms.
- 5.2.5. Principles of handling and transportation of food – stuff
- 5.2.6. Principles of processing flow, techniques and food preservation
- 5.2.7. Basics of thermo-dynamics and mechanical operations during food processing
- 5.2.8. Properties and uses of different food packaging materials.
- 5.2.9. Basic principles and practices of cleaning and sanitation in food processing operations.
- 5.2.10. Organoleptic qualities of food.
- 5.2.11. The national and international legislation and agencies relevant to the food quality.
- 5.2.12. The recycling of food by-products and treatment food industry wastes.

5.3. Practical skills

Graduates of food sciences Program must acquire the following knowledge and understanding:

- 5.3.1. Analyze food physically, chemically and microbiologically
- 5.3.2. Identify storage problems and affiliated causes in processing technology

- 5.3.3. Select appropriate package for processed food
- 5.3.4. Operate basic food processing equipment
- 5.3.5. Apply the good manufacture practices (GMP).
- 5.3.6. Monitor sanitary food delivery and transportation system
- 5.3.7. Implement the principles of food processing and preservation methods
- 5.3.8. Control deterioration and spoilage of raw materials and processed food.
- 5.3.9. Detect food adulteration.
- 5.3.10. Apply quality control standards and assure food safety

5.3.A. Additional skills for dairy technology option

- 5.3.A.1. Process native dairy products
- 5.3.A.2. Perform concentration and ice cream mixtures calculations.
- 5.3.A.3. Evaluate dairy products

5.3.B. Additional skills for food processing option

- 5.3.B.1 Process traditional foods
- 5.3.B.2. Grade/evaluate meat and fish products.
- 5.3.B.3. Process cereal grains.
- 5.3.B.4. Formulate daily dietetic requirements
- 5.3.B.5. Process edible oils, vegetables, fruits, sweeteners, brewing products and oil products.
- 5.3.B.6. Process vegetables and fruits
- 5.3.B.7 . Process sweeteners and brewing products
- 5.3.B.8. Process functional food

5.3.B.9. Process sugar and its products.

5.4. Intellectual skills

Graduates of food sciences Program must acquire the following knowledge and understanding:

- 5.4.1. Apply mathematical and statistical principles to food industry
- 5.4.2. Identify and solve basic processing problems.

6. National Academic Reference Standards For Agriculture Socio-Economic Program

Agricultural socio-economic program includes two majors; agricultural economics, and rural sociology and agricultural extension. Economics of the firm, consumer behavior, value chain of agricultural products, characteristics and dynamics of rural societies, and agricultural extension techniques and plans are the main areas of concern of this program.

Graduates of this program have several career opportunities including: Banking/ farm lending institutions, international trade, agribusiness firms, product distributors/ marketing, consultancy services, extension agencies and media, and cooperatives and national and international governmental and non-governmental organizations, educational and research institutions and development projects

6.1. Attributes of the Agricultural Socio economic graduate Graduates of Agriculture Socio-Economic Program must

be able to:

- 6.1.1. Make decisions based on economic and social principles
- 6.1.2. Predict the impacts of economic and social changes
- 6.1.3. Disseminate the results of applied agricultural research and technology transfer to different end users.

6.2. Knowledge and understanding

Graduates of Agriculture Socio-Economic Program must acquire the following knowledge and understanding:

- 6.2.1. Principles of producer and consumer behavior under different market structures
- 6.2.2. Principles of production economics and farm management analysis
- 6.2.3. Producer response to changes in prices of inputs and/ or outputs
- 6.2.4. Investment analysis techniques and credit worthiness' analysis
- 6.2.5. Features and dynamics of spot and future markets for agricultural commodities
- 6.2.6. Different stages of value chain analysis and its relation to marketing and business planning
- 6.2.7. Farm records, and book-keeping and prepare different financial statements for farm or agribusiness entities
- 6.2.8. Socio economic research methods
- 6.2.9. Fundamentals of quantitative and qualitative analysis methods
- 6.2.10. Principles of designing, implementing and evaluating extension programs
- 6.2.11. Human resource development approaches
- 6.2.12. Rural community structure, dynamics, and methods of cultural change
- 6.2.13. Principle of community needs assessment and situation analysis

6.2.14. Principles information technology economics, e-commerce and e-marketing

6.2.15. Principles of experimental economics

6.3. Practical skills

Graduates of Agriculture Socio-Economic Program must be able to:

6.3.1. Apply different techniques of socio-economic analysis.

6.3.2. Propose, design, and implement social and economic agricultural surveys and sampling.

6.3.3. Use different statistical packages.

6.3.A. Additional skills for economics option

6.3.A.1. Design a farm business plan

6.3.A.2. Conduct cost / benefit analysis of an agricultural project

6.3.A.3. Calculate credit option for investment and calculate rates of return.

6.3.A.4. Develop marketing plan for agricultural enterprise and agribusiness.

6.3.A.5. Create book-keeping system for an agricultural enterprise and manage and maintain financial records.

6.3.B. Additional skills for agricultural extension option

- 6.3.B.1. Plan for rural community development
- 6.3.B.2. Conduct situation analysis and assess rural needs
- 6.3.B.3. Design an agricultural extension program.
- 6.3.B.4. Conduct a training needs assessment
- 6.3.B.5. Design a training plan based on the **needs** assessment.
- 6.3.B.6. Simplify the agricultural research findings
- 6.3.B.7. Rephrase farming problems in a scientific form.

6.4. Intellectual skills:

Graduates of Agriculture Socio-Economic Program must be able to:

- 6.4.1. Identify and utilize sources of information needed for problem identification and manipulation.
- 6.4.2. Extract results from available information

7. National Academic Reference standards for Biotechnology Program

The NARS of this program include the knowledge, understanding and skills required to build the graduate capacity. Sciences of genetics, biochemistry, microbiology, botany, zoology, ecology, propagation, entomology, horticulture, agronomy, plant and animal breeding and propagation comprises the main sciences of this program.

Career opportunities for the graduates in this program are agri-business and pharmaceutical firms, gene banks, seed technology firms, food and feed industry, biotechnology laboratories and research institutes.

7.1. Attributes of Biotechnology Graduates

Graduates of Biotechnology program must be able to:

- 7.1.1. Apply biotechnological tools for improving productivity of plants and animals
- 7.1.2. Adopt different molecular techniques in agricultural development programs
- 7.1.3. Integrate knowledge and procedures to produce genetically modified organisms
- 7.1.4. Use biotechnological applications in agro-industries and ecology maintenance
- 7.1.5. Follow the bio-safety regulations in production of genetically modified organisms.

7.2. Knowledge and understanding

Graduates of Biotechnology program must acquire the following knowledge and understanding:

- 7.2.1. The interdisciplinary sciences relevant to biotechnology
- 7.2.2. Applications of biotechnology in agriculture development and environment maintenance.
- 7.2.3. Techniques of tissue culture and its application
- 7.2.4. Role of recombinant DNA in manipulating organisms
- 7.2.5. Genome, genomics, proteomics and bioinformatics
- 7.2.6. Process and procedures involved in animals and plants biotechnology
- 7.2.7. Use biotechnology in control and diagnosis of plant diseases
- 7.2.8. Production of biological by-products via bioreactors
- 7.2.9. Importance of biotechnology on food industry and safety.
- 7.2.10. Basics of pathogenicity and the production of pathogen and contaminant-free plants.
- 7.2.11. Biotechnological aspects of bio-fertilizers and bio-pesticides
- 7.2.12. Biotechnological bases for conservation of genetic resources
- 7.2.13. International social and ethical standards of biotechnology application.
- 7.2.14. Economics of biotechnology application.

7.3. Practical skills

Graduates of Biotechnology program must be able to:

- 7.3.1. Provide technical support on agricultural biotechnology problems
- 7.3.2. Use biotechnology in executing plant and animal improvement plans.
- 7.3.3. Apply biotechnological techniques in the treatment of environmental pollution.
- 7.3.4. Perform research and diagnostic tests and outlined protocol to achieve goals.
- 7.3.5. Use of biotechnological tools to develop valuable by-products.
- 7.3.6. Apply molecular markers in plants and animals selection programs.
- 7.3.7. Use tissue culture techniques in commercial plant production
- 7.3.8. Apply molecular genetics for the manipulation of genetic materials of microorganisms in food/feed technology, bio-fertilizer and bio-pesticide.
- 7.3.9. Apply appropriate laboratory procedures to handle, archive or dispose samples safely.
- 7.3.10. Produce secondary products via bioreactors.
- 7.3.11. Identify genetically manipulated organisms.

7.4. Intellectual skills

Graduates of Biotechnology program must be able to:

- 7.4.1. Evaluate the role of genetic diversity in evolutionary processes
- 7.4.2. Use bioinformatics methods in the analysis of biotechnology data.

8. Agricultural Engineering Program

The agricultural engineering program is concerned with proper use of machineries at the different stages of agricultural production and processing systems. In addition to engineering and agricultural basic and applied sciences, the program provides specialized sciences that cover the disciplines of farm

power and machinery, food and post harvest engineering, farm irrigation and drainage engineering and farm building and bioenvironmental engineering .

Graduates in this program will have the opportunity to work in farms, agricultural machinery stations, soil reclamation companies, irrigation and drainage projects, harvesting and grading crops stations, agricultural construction firms, agricultural machinery agencies food, research centers and feed industry.

8.1. Attributes of Agricultural Engineering graduates

Graduates of Agricultural Engineering program must be able to:

- 8.1.1. Participate in management of agricultural mechanization stations.
- 8.1.2. Operate and maintain irrigation and drainage systems.
- 8.1.3. Plan an agro-industrial complex.
- 8.1.4. Implement the appropriate irrigation system to manage water resources efficiently.
- 8.1.5. Work with machines, equipment and tools in a safe manner.

- 8.1.6. Participate in processes related to farm building construction.

8.2. Knowledge And Understanding

Graduates of Agricultural Engineering Program must acquire the following knowledge and understanding:

- 8.2.1. Principals of plant and animal biology and agricultural production systems
- 8.2.2. Bases of engineering applications in irrigation systems and drainage.
- 8.2.3. Concepts of conventional and non-conventional renewable energy and sources.
- 8.2.4. Basics and components of hydraulic systems.
- 8.2.5. Structural parts of buildings and types of materials.
- 8.2.6. Land surveys
- 8.2.7. Fundamentals of establishment and managing water wells.

8.3. Practical skills

Graduates of Agricultural Engineering program must be able to:

- 8.3.1. Determine appropriate agriculture equipment to meet the intended needs.
- 8.3.2. Select and safely operate agriculture equipment and shop tools.
- 8.3.3. Implement and manage irrigation systems.

- 8.3.4. Design agricultural buildings and control the micro-environment
- 8.3.5. Test the performance of agricultural production and processing machinery and systems.
- 8.3.6. Disassemble and assemble machine parts.
- 8.3.7. Draw maps and execute topography surveys
- 8.3.8. Select the appropriate pumps for well establishment
- 8.3.9. Participate in teams of well establishment.

8.4. Intellectual skills

Graduates of Agricultural Engineering program must be able to:

- 8.4.1. Evaluate the design and performance of agricultural equipment and machinery.
- 8.4.2. Solve engineering problems applying mathematics and engineering sciences.
- 8.4.3. Trouble shoot and diagnose malfunction pertaining to agricultural machineries.
- 8.4.4. Estimate loss in harvesting processes.
- 8.4.5. Calculate the required power needed to field works.
- 8.4.6. Analyze systems of agriculture matrix

II. Curriculum Structure

The percentages mentioned in the following table for each area of study is just a guide for faculties of agriculture and not obligatory to follow.

#	Area of study	Range (%)	Science Characterization
1	Basic Sciences	30 – 35	Chemistry, Physics, Botany, Zoology, Physiology, Genetics, Statistics, Mathematics.
2	Humanities and Social Sciences	5 – 12	Economics, Sociology, English, Administration, Communications
3	Core Sciences	40 – 45	Varied among programs
4	Field Training & projects	5 -7	Field training and capstone courses
5	Information Technology	3-5	Basics of IT, application of IT in the profession
6	Discretionary subjects *	7-8	

- Allowed to each faculty to used based on its mission

III. Glossary

1. Institution

A University, faculty or higher institute providing education programs leading to a first university degree or a higher degree (Master's or Doctorate).

2. Graduate Attributes

Competencies expected from the graduate based on the acquired knowledge and skills gained upon completion of a particular program.

3. National Academic Reference Standards (NARS)

Reference points designed by NAQAAE to outline / describe the expected minimum knowledge and skills necessary to fulfill the requirements of a program of study.

4. Academic Standards

Reference points defined by an institution comprising the collective knowledge and skills to be gained by the graduates of a particular program. The academic standards should surpass the NARS, and be approved by NAQAAE.

5. Subject Benchmark Statements

Guideline statements that detail (enumerate) what can be expected of a graduate in terms of the learning outcomes to

satisfy the standards set for the program. They enable the outcomes to be compared, reviewed and evaluated against agreed upon standards.

6. The Program

A set of educational courses and activities designed by the institution to determine the systematic learning progress. The program also imparts the intended competencies required for the award of an academic degree.

7. Intended Learning Outcomes (ILOs)

Subject-specific knowledge, understanding and skills intended by the institution to be gained by the learners completing a particular educational activity. The ILOs emphasize what is expected that learners will be able to do as a result of a learning activity.

8. Knowledge and Understanding

Knowledge is the intended information to be gained from an educational activity including facts, terms, theories and basic concepts. Understanding involves comprehending and grasping the meaning or the underlying explanation of scientific objects.

9. Intellectual Skills

Learning and cognitive capabilities that involve critical thinking and creativity. These include application, analysis, synthesis and evaluation of information.

10. Professional and Practical Skills

Application of specialized knowledge, training and proficiency in a subject or field to attain successful career development and personal advancement.

11. General and Transferable Skills

Skills that are not subject-specific and commonly needed in education, employment, life-long learning and self development. These skills include communication, team work, numeracy, independent learning, interpersonal relationship, and problem solving... etc.

