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Draft

National Academic Reference Standards (NARS)
For
Basic Sciences

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Gratitude

Draft

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NARS and NARS Characterization

National Academic Reference Standards (NARS) statements provide measures for the academic community to describe the nature and characteristics of academic programs in certain field of specialty. They also represent general expectations about the qualifications, the attributes and capabilities that the graduates of those programs should be able to demonstrate.

NARS is followed by a NARS Characterization where more explanations for the NARS of a specific discipline are introduced. NARS Characterization part sheds the light on the university, faculty and program general requirements.

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Section 1 General

Basic Sciences

NATIONAL ACADEMIC REFERENCE STANDARDS (NARS)

FOR BASIC SCIENCES

1-Introduction

The aim of science seeks to understand the nature and justification of scientific knowledge. Basic sciences, including chemistry, physics, mathematics and biosciences, furnish the basis for all scientific disciplines.

Physics is concerned with the observation, understanding and prediction of natural phenomena and the behavior of man-made systems. It deals with profound questions about the nature of the universe and with some of the most important practical, environmental technology issues. Its scope is broad and involves mathematical theories, experiments and observation, computing technology, materials, nuclear energy and magnetism.

Chemistry is the science concerned with the study of elements present in nature, their physical and chemical properties, and understanding the interaction of various types of elements forming chemical compounds.

The biosciences are the study of life at all levels of complexity from molecules to populations. Whilst life-forms are built from relatively few different types of atoms, these are assembled into ever more complex levels of organization in molecules, cells, tissues, organs, organisms, communities and ecosystems.

Geology is the fundamental earth science which attempts an intelligent interpretation of the products resulting from these natural processes acting on and in the earth. Geology is very broad science and therefore has a number of subdivisions such as petrology, structural geology, dynamic geology, geomorphology, paleontology, historical geology, economic geology and geophysics.

Mathematics study address the more general and fundamental mathematical concepts. It provides a selection of more advanced topics. It develops investigative mathematical computational modeling and any additional new information according to the progress in different mathematical fields.

2-THE ATTRIBUTES OF THE BASIC SCIENCES GRADUATES

The ability to:

1. Communicate with others effectively.
2. Use effectively IT technology relevant to the field.
3. Participate in a multidisciplinary teamwork and be flexible for adaptation and working under contradictory conditions.

4. Establish new concepts and choose appropriate solutions to solve problems.
5. Use scientific facts and theories to analyze and interpret experimental results.
6. Search for required information and adopt self-learning.
7. Possess broad ethical principles to show commitment to ethical practice and social responsibility.
8. Exhibit the sense of beauty and neatness.
9. Show leadership and decision making capabilities.
10. Design system components to meet the required needs of community such as economic, environment, society, politic, ethics, safety and manufacture.

3- National Academic Reference Standards (NARS) for basic Sciences

National Academic Reference Standards (NARS) statements provide measures for the academic community to describe the nature and characteristics of academic programs in a certain field of specialty. They also represent the general expectations about the qualifications, attributes and capabilities that the graduates of those programs should be able to demonstrate. The following qualifications should be achieved by the science graduates to fit with the NARS level.

3.1. Acquiring Knowledge and understanding:

Graduate must acquire the knowledge and understanding of:

1. The related basic scientific facts, concepts, principles and techniques.
2. The relevant theories and its applied sciences.
3. The processes and mechanisms supporting the structure and function of the specific topics.
4. The related terminology, nomenclature and classification systems.
5. The theories and methods applied for interpreting and analyzing data. Related to discipline
6. The developmental stages of the program-related knowledge.
7. The complexity and diversity of the study-subject through the study of representative program elements.

3.2. Intellectual Skills:

Graduate must be able to:

1. Evaluate and interpret qualitatively and quantitatively science relevant data.
2. Develop lines of argument and appropriate judgments in accordance with the scientific theories and concepts.
3. Postulate and deduce mechanisms and procedures on scientific basis.
4. Differentiate between subject-related theories and assess their concepts and principles.
5. Analyze, synthesize and summarize information critically.
6. Construct several related integrated information to confirm, make evidence, and test hypotheses.
7. Assess the impact and the interrelationships of data.

3.3. Practical and professional skills:

Graduate must be able to:

1. Plan, design, conduct and report on the investigated data with limited guide.
2. Obtain record, collect and analyze data using appropriate techniques.
3. Apply investigations using systems, techniques, and tools considering the scientific ethics.
4. Prepare, analyze, and present data in its appropriate format accurately.
5. Solve problems using a range of formats and approaches.
6. Identify and criticize the different methods used for preparing, processing, interpreting and presenting data.

3.4. General and transferable skills

Graduate must be able to:

These skills are common for all basic science disciplines

1. Use information and communication technology.
2. Identify roles and responsibilities and their performing manner.
3. Think independently, set tasks and solve problems on ethical scientific basis.
4. Work in group, and communicate with others positively.
5. Consider community linked ethics and traditions.
6. Acquire the life-long learning and considering the community-linked problems.
7. Deal with scientific data in Arabic and English.
8. Use effectively scientific models, systems, and tools.
9. Market of scientific patents.
10. Exhibit the sense of beauty and neatness.

4. NARS CHARACTERIZATION FOR DIFFERENT BASIC SCIENCES DISCIPLINES

4.1 Criteria for content of Basic Science program

Range of required hours of program 140-150 hours

Table 1: Indicative minimum curriculum content

Branch of science	Percentage %	Tolerance
Basic Science	21	20-22
Humanities (including language)	6	5-7
Specialty (professional)	50	48-52
Computer and IT	6	5-7
Elective studies	7	6-8
Research and graduation project	2	1-3
Others (Discretionary)	8	7-9
Total	100	100%

4.2. Definition of Subject Areas

4.2.1. Humanities and Social Sciences

These are sciences concerned with subjects that explore and examine issues important to human societies. These subjects intend to provide basic sciences graduate with general knowledge and intellectual skills (rather than professional skills) that strengthen their consciousness to the society and its culture. Such subjects encourage an understanding of the nature and quality of life in a multi-cultural society and an appreciation of the diversity of values and beliefs. The skills and understanding raised by humanities and social sciences can equip basic sciences graduates to play an active well informed role in the community development, and prepare them for further education in a rich range of fields.

4.2.2 Fundamentals of Basic Sciences

These are sciences needed for students to acquire knowledge about nature and its phenomena, including quantitative expressions. These fundamentals include general chemistry, calculus-based mathematics, general physics, biosciences, and earth sciences; which should be utilized to satisfy the basic sciences requirements. Fundamentals should emphasize concepts and principles.

4.2.3 Basic Sciences

Basic sciences, including chemistry, physics, mathematics and biosciences, furnish the basis for all scientific disciplines.

1. Physics is concerned with the observation, understanding and prediction of natural phenomena and the behavior of man-made systems.
2. Chemistry is the science concerned with the study of elements and compounds present in nature and their physical and chemical properties.
3. Biosciences are the study of life at all levels of complexity from molecules to populations.
4. Geology is the fundamental earth science which attempts an intelligent interpretation of the products resulting from natural processes acting on and in the earth.
5. Mathematics constitutes a body of established facts, achieved by a reliable method, verified by practice, and agreed on by a consensus of qualified experts.

4.2.4 Computing and IT

Computing and IT subjects acquire student knowledge and skills necessary for understanding how to use computers and other information technology as tools for organization, communication, research, and problem solving.

4.2.5. Research and Graduation Project

This project allows students to plan, investigate, and execute research in their discipline to utilize knowledge and experience of applying the principles and techniques introduced in the program of study.

4.2.6. Discretionary (Institution Character-identifying) Subjects

These are subjects selected by the institution to identify its character, and to recognize, appreciate and respond effectively to the needs of the society.

4.3 Pre-requisites to Students Admission

Egyptian secondary school certificate (science and mathematics groups), or other equivalent certificates.

National Academic Reference Standards (NARS) For Chemistry

5. Introduction

Chemistry is the science which deals with the study of atoms and molecules with a great emphasis on their structures, properties, synthesis, and how they interact with each other to create new molecules. Its range and compass are enormous, from the simplest compounds like sodium chloride up to huge and complex biological molecules such as DNA and proteins which form the basis of life itself. Chemistry in turn, draws on the facts and theory of physics and mathematics for the tools necessary to evaluate and express quantitative chemical information. Therefore, knowledge of the dynamic and the evolving science of chemistry is central to the discovery, understanding and development of other sciences like; biology, medicine, pharmacy, materials science, engineering and many other related sciences.

The study of chemistry provides the concepts, knowledge, principles and theories necessary for the intellectual framework of understanding the properties of atoms and molecules as well as the relationship between structure and reactivity from fundamentals to the frontiers of current research. It also focuses strongly on a wide range of analytical and experimental skills required to practice the subject. Chemistry enables students to examine changes of materials during mixing, freezing, heating and dissolving, and then learn how to observe and measure results. Laboratory investigations of the properties of substances and their changes through a range of chemical interactions provide a basis for students to understand atomic theories and a variety of reaction types and their applications in different fields.

Studying for a degree in Chemistry is a sound basis from which the students launch their career. Apart from extending their knowledge of the subject, they will develop many of the scientific and employability skills, which are necessary for most occupations. The study of chemistry includes a degree in single honors in chemistry as well as joint degrees with other disciplines, where chemistry represents a main share.

Chemists can have opportunities to work as scientists in research activities in national centers, governmental agencies and private laboratories. They also are employed as product developers and quality control of manufactures in the industrial sectors. Chemists can utilize their broadly based chemistry knowledge and skills in other areas such as sales representative for chemical products, pharmaceuticals or laboratory equipment. In addition, chemistry graduates can be involved as academia in the public and private learning institutions.

6. The Attributes of a Chemist

It is important to identify the attributes that chemist is expected to develop during his study for B.Sc degree in chemistry so that he can present them effectively to prospective employers.

The ability to

1. Solve common problems related to chemistry based on ethical and social issues, recognize novel problems and investigate them practically.

2. Design and conduct experimental work, critically evaluate the outcomes, review and report on practice.
3. Have knowledge and experience of working with relevant and advanced laboratory techniques.
4. Participate in and review quality control processes, manage risk and organize time to finish jobs.
5. Use IT effectively for independent learning and development of skills and knowledge.
6. Work with others in a team, communicate both oral and written, listen, and convey complex information, present scientific material and arguments clearly and correctly.

7. National academic reference standards (NARS) for chemistry:

The academic reference standards represent general expectations about the standards for the award of qualifications at the B.Sc degree in chemistry, and articulate the attributes and capabilities that the graduates should be able to demonstrate. To keep innovation in the program development and in the design of learning experiences, each institution is free to decide about the content, nature and organization of the courses or modules. Regardless of the institution, the undergraduate chemistry programs should provide students with an education in the main branches of chemistry, namely;

1. Analytical chemistry: the study of the structure, composition and nature of substances,
2. Inorganic chemistry: the study of non-carbon-based compounds,
3. Organic chemistry: the study of carbon-based compounds,
4. Physical chemistry: the study of characteristics of atoms and molecules and chemical reactions,
5. Computational chemistry: the study of the theories of quantum mechanics.

a. Acquiring Knowledge and understanding

The chemistry graduate must be able to demonstrate knowledge and understanding of:

1. Chemical concepts, nomenclature, formula and units.
2. Characteristics of the different states of the matter and elements including trends within the periodic table and the related theories.
3. The principles, procedures and techniques used in chemical analysis, characterization and structural investigations of different chemical compounds.
4. The major types of chemical reactions, their characteristics and mechanisms as well as their kinetics including catalysis.
5. The principles of thermodynamics and quantum mechanics including their applications in chemistry.
6. The constitution and properties of the different chemical compounds, including the main synthetic pathways and the relation between the properties of individual atoms and molecules.
7. The current issues of chemical research and technological development.
8. The importance of chemistry in other areas of science, technology and industry.

7.2. Skills

The graduate at the bachelors' honors degree in chemistry should be able to demonstrate a wide range of different subject-related skills which are:

7.2.1. Intellectual skills

The graduate must be able to demonstrate and develop his ability to:

1. Apply knowledge and understanding of chemical concepts and principles to the solution of familiar problems in both qualitative and quantitative manners.
2. Recognize and analyze novel problems, plan and use elements of scientific inquiries for their solution.
3. Synthesize, evaluate, and interpret of chemical data and information.
4. Differentiate between the different states of the matter, elements and compounds based on the recognition and quantification of the properties.
5. Employ computation and data-processing skills in handling of chemical information and data analysis.
6. Explain concepts and determine the efficiency of chemical systems by applying the mathematical expressions.

7.2.2. Practical and professional skills

The graduate must be able to demonstrate and develop his ability to:

1. Assess risk in laboratory work taking into account the specific hazards associated with the use of chemical materials as well as the safe and proper operation of the laboratory instruments.
2. Conduct standard laboratory procedures involved in analytical and synthetic work.
3. Monitor (by observation and measurements) the chemical properties or changes, including the systematic recording and technical reporting thereof.
4. Plan, design and execute practical measurements, from the problem recognition stage to the evaluation and interpretation of results.
5. Use computational packages and tools in laboratory work.

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National Academic Reference Standards (N A R S)

Biological Sciences

5. Introduction

Biological Sciences are major subjects in the higher education system. The study of Biological sciences are emphasize mainly on: the study of biological elements (species, or infra-specific taxonomy), and its relation to the environment, ecosystem, protection and conservation, in addition economics, utilization, interaction, breeding of these biological elements are also among the main topics.

Biological sciences contribute to the human health, wealth of the nation and disease fundamentals through the study of the microorganisms and related topics, together with the development of new vaccines, drugs and antibiotics. Knowledge of biology is essential for a viable human future. It is therefore important for leaders of society whether in government, industry, business or education to appreciate this and for an informed electorate to understand the scope and limitations of biological knowledge and techniques. Only then can we face the challenging social, ethical and legal problems posed by new developments such as stem cell cloning, gene patenting and gene therapy while working to maintain biodiversity and a stable and sustainable environment.

The extent of the Biological Sciences, studied under many different titles and in many different sorts of departments, schools, faculties, and institutions. Some biologists are ecologists and will do much of their work in the field. Many work in laboratories: some in university departments, others in the biotechnology, pharmaceutical, health, and food industries. Biological science is divided into many specializations such as biology, biological sciences and life sciences; there are sub-disciplines within this area that focus on particular groups of organisms (e.g. entomology, botany, zoology). Other degrees are located as interdisciplinary specialization among of them: biophysics, biochemistry, biotechnology, marine biology, microbiology-chemistry, oceanography, oceanography-chemistry, Environmental biogeochemistry, etc....)

Biological Sciences, serve as basic information for wide range of disciplines such as medicine, veterinary medicine, dental medicine and agriculture. Students belonging to the earlier mentioned disciplines take an 'intercalated' honors course; these courses are frequently shared with biological sciences students. However, the National Academic Reference Standards applied to each discipline is that addressed to the graduate sector name (the Biology department in faculty of science referred to the NARS of basic science, while the graduates Biology department in Faculty of Agriculture referred to the Agriculture NARS; etc...).

Biological Sciences are the study of life at all levels of complexity from molecules to populations. Whilst life-forms are built from relatively few different types of atoms, these are assembled into more complex levels of organization in molecules, cells, tissues and organs forming organisms. Other level of complexity related to species, family, population, communities, and ecosystems including the inter-relationships between living organisms. The

study of biological sciences includes also the understanding of life's basic processes among of them; physiology, respiration, metabolism, movement, sensation, digestion, breeding, interaction, and competition.

Recently, biologist is working in disciplines that might previously have been classified among the unrelated topics such as: physical sciences, organic chemistry, drug interaction, engineering, informatics, statistics and software. The development in such disciplines has begun to collaborate with biologists to form multidisciplinary teams tackling topics such as the human genome project and bioengineering.

There are various job opportunities in biology as it is an ever expanding field within the biotechnology sector, some career options may include: Secondary School Teacher - With skills ascertained from a biology degree, graduates have the option of developing the knowledge of secondary students, usually this requires some form of education associate degree/diploma in education, but is a viable option for any graduate. Research Scientist in Biology in academic institutions and the graduate may have positions at the following: in drug companies, biotechnology firms, food companies, fruit growers, chemical companies, biological supply houses, environmental consultant, Pathologist, animal and wildlife educator or rehabilitator, animal behaviorist zoo curator, entomologist, pests-control to homeowners, farmers and others.

6. Student attributes in Biological Sciences

The ability to:

1. know, understand, assess, evaluate and recognize different levels of organization in biological systems: cells, tissues and organs, organisms
2. Identify, characterize different communities and ecosystems supporting the biological organism.
3. Acquire the modern subjects and techniques as molecular biology and nanotechnology.
4. Understanding of life's basic processes in relation to organisms and ecosystems.
5. Function within multi-multidisciplinary teams.
6. Acquire the basics of numeric and computational tools (such as: IT, statistics, bioinformatics and the newly developed subject).
7. Collect, summarize and present data, undertake professional and ethical responsibilities.
8. Design, conduct and interpret data of practical investigations (in labs or fields).
9. Work in group, and communicate effectively with others.
10. Criticize, postulate solutions, and deduces the solutions mechanisms and develops judgments in scientific bases.

7. National Academic Reference Standards of Biological Sciences

National Academic Reference Standards mentioned here justify and characterizes the skills and achievements of the from Biological sciences graduate students. Biological Sciences described here are those related to basic science sector, addressed mainly to the graduates from Faculty of Science (Zoology, Botany and Entomology as major degree, double

majors and subsidiary specialization (microbiology, marine biology, microbiology-chemistry, oceanography, oceanography-chemistry, Environmental biology, ...)

7.1 Knowledge and understanding in biological sciences

The range of courses covered by an individual program will depend on the specific degree offered and the institutional context. The designed curricula by any institution must provide students with abundant choice. Various programs related to biological sciences must be emphasize on theoretical knowledge, practical periods, field works and other related semester works (posters, seminars, data presentation, group work, data collection, etc....). The curricula also must be flexible to some extent to encourage the courses content enhancement, especially the topics related to environment, molecular biology, bioinformatics and other new research areas.

Approaches to study and forms of subject knowledge specific for the biological sciences degree programs will include: a broadly-based core covering the major elements defined by the particular program and providing the wider context required for the subject area among the basic sciences (e.g. physics, mathematics, chemistry, Law, humanities, etc...). The biological science graduate must be has the following knowledge, before his graduation from a certain study program:

Acquiring knowledge and understanding of:

1. Processes and mechanisms that have shaped the natural world in terms. For example, the complexity from the environmental to the cellular.
2. The influence of living organism in environment and vise versa.
3. The terminology, nomenclature and classification systems allocated to his biological organism/s.
4. The methods applied for interpreting and analyzing biological information.
5. The developmental stages of the program related organisms and its evolution.
6. The taxa limit and numerate the characteristic habitat features of common organisms.
7. The physiological aspects of organisms.
8. The complexity and diversity of life processes through the study of representative organisms, their molecular, cellular and physiological processes, their genetics.

7.2 Skills

The biological science graduate at the bachelor's honors degree in should be able to acquire a wide range of different skills numerated as follows:

7.2.1 Intellectual skills

The ability to:

1. Compare and differentiate between subject-related theories and assess their concepts and/or principles.
2. Analyzing, synthesizing and summarizing information critically, including published research or reports.

3. Construct several integrated lines related to the specific subject to confirm, make evidence, and test hypotheses.
4. Interpret the subject knowledge and understanding to solve a problem.
5. Formulate data, and select the proper mechanism of its setting within a theoretical framework.
6. Modify the available data or theory to cope with the specific subject.
7. Assess the impact and the interrelationships between a specific organism and its ecosystems.
8. Confirm results with different scientific based issues.
9. Deduce a scientific output from the given information.

7.2.2 Professional and Practical skills

The ability to:

1. Compare between different methods or theories to judge the priority of one of them.
2. Assess the received data or samples and responding to a variety of sources of information: textual, numerical, verbal, graphical.
3. Solve of certain problem using a range of formats and approaches, present this subject appropriately to a variety of audiences.
4. Summarize a certain topic, citing it in appropriate manner, with supporting references.
5. Recommend the methods used for: preparing, processing, interpreting and presenting data, using appropriate qualitative and quantitative techniques, statistical programs, spreadsheets and programs for presenting data visually.
6. Solving problems by a variety of methods including the use of computers, and/or other recent tools.
7. Designing, planning, conducting and reporting on investigations, which may involve primary or secondary data (e.g. from a survey database).
8. Obtaining, recording, collecting and analyzing data using appropriate techniques in the field and/or laboratory.
9. Applying field and/or laboratory investigations of living systems in a responsible, safe and ethical manner.
10. Preparation of laboratory and field facilities to carry out certain experiment.
11. Examine the related biological organ or system and relate it to its group.
12. Prepare, analyze, present data of an experiment in digital or poster form.
13. Selection of a representative sample; recording and analyzing data in the field and/or the laboratory considering its validity, accuracy, calibration, precision, reliability and uncertainty during collection.

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National Academic Reference Standards (N A R S) for physics

5. Introduction

Physics is the study of energy and the behavior of single atoms and their component species. Physicists are the most fundamental of scientists, for they examine the basic laws of nature. They seek to study and understand what happens when atoms and subatomic particles break down and assemble how they react to collisions with each other and to electro-magnetic radiation.

Physics is the foundation upon which the other physical sciences such as; astronomy, chemistry and geology are based. The beauty of physics lies in the simplicity of the fundamental physical theories and in the manner in which just a small number of fundamental concept, equation, and assumptions can alter and expand our view of the world around us.

Like all sciences, physics is based on experimental observation and quantitative measurements. The main objective of physics is to use a limited number of fundamental laws that govern natural phenomena to develop theories that can predict the results of future experiment. The fundamental laws used in developing theories are expressed in the language of mathematics, the tool that provides a bridge between theory and experiment.

When a discrepancy between theory and experiment arises, new theories and experiments must be formulated to remove the discrepancy. Many times a theory is satisfactory only under limited conditions; a more general theory might be satisfactory without such limitations.

Scientists are constantly working at improving our understanding of fundamental laws, and new discoveries are being made everyday. In many research areas, there is a great deal of overlap between physics, chemistry and biology as well as engineering.

The NARS statements for physics sets out generic statements represent general expectation about standards for degrees in physics. These statements clarify those attributes that are associated with the award of physics degrees, how such awards accord with the frameworks for physics education qualification in Egypt.

After graduate study, physicists have been expected to become investigators in industrial or government research and development laboratories. They can also have careers in aircraft & instrument manufacturers, chemical manufacturers, information technology companies, research and educational institutions, educational institutions, electrical equipment companies, health care facilities, scientific journals, technical consulting firms, Staff University and testing labs.

6. The Attributes of a Physicist

The ability to:

Have a good basic knowledge of structural and functional aspects of physical systems at many spatial scales, from single molecule to the whole system.

Connect fundamental ideas about the physical behavior of matter and energy to system's structure and function.

Apply knowledge of scientific concepts to the solution of complex physical problems.

Design and conduct experiments and to analyze and interpret data.

Function within multi-disciplinary teams.

Understanding of professional and ethical responsibilities.

Communicate effectively.

7. National Academic Reference Standards (NARS) for Physics:

For the physics branch, NARS was followed by a NARS characterization where more explanations for the NARS of a specific specialty were introduced.

7.1 Knowledge and understanding of physics.

The various programs of physics will emphasize different areas, for example, theoretical and applied physics programs. Practical work should thus be a vital and challenging part of a physics degree, and all graduates in physics, should also become proficient in presenting experimental results in deducing conclusions and in writing of scientific reports.

Acquiring knowledge and understanding of:

1. Characteristics of matters.
2. Static and dynamic properties of fluids.
3. The Basics of Electricity.
4. Concepts of electromagnetism.
5. Principles of heat transfer and thermodynamics.
6. Theoretical and practical aspects of optics, nuclear and other branches of physics.
7. Application of advanced physical technology.
8. Basics and types of energy transfer.
9. Basics of computer technology.
10. Different branches of chemistry.
11. Basics and advanced programs of Mathematics.

7.2 Skills

7.2.1 Intellectual skills.

The ability to:

1. Use theories of physics to interpret results.
2. Use effectively principles of physics in analyzing signals originated from physical systems.
3. Apply appropriate physical principles to create and analyze system components.
4. Choose optimum solutions for physical problems based on analytical thinking, taking into concern different constraints such as safety, quality, environmental impacts and ethics.

7.2.2 Practical and professional skills.

The ability to:

1. Apply mathematical tools and techniques to analyze and interpret experimental results.
2. Implant comprehensive physical knowledge and understanding as well as intellectual skills in research tasks.
3. Use the national standards for laboratory equipments which essential for practical research work.
4. Make a prior choice through laboratory coursework. The training program is to prepare the student to be an independent scientist.
5. Present theoretical and experimental results in understandable forms such as tables and graphs.

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National Academic Reference Standards (NARS) for Biophysics

5. Introduction

This subject standards statement characterizes the skills and achievements that graduate of biophysics degrees should have. There is a wide range of such classification of biophysics such as, cell membrane biophysics, radiation and environmental biophysics, biophysics of macromolecules and sub-cellular components, nuclear magnetic resonance (NMR) in medicine and biology, control and communication processes in living system, and others.

The biophysics speciality share a common interest in combining biology and physical principles to solve important research questions in biological systems and medical sciences. Biophysics branch study the structure and function of proteins, nucleic acids and lipids at the single molecular level. They investigate dynamics in areas such as vision and motility as well as molecular structure; signal transduction, transmission in nerve and muscle; cell to cell and cell to substrate interactions; structural determination of biological macromolecules and tissues by using various spectroscopic and microscopic methods. This discipline has wide industrial applications (Biomaterials), in medicine, (radiotherapy and radio diagnosis).

Biophysics is an interdisciplinary science that applies the theories and methods of physical sciences to questions of biology. The study of biophysics addresses how macromolecules and their complexes function. Its focus in mechanism, prediction and application is relative to biological processes. Biophysicists use the ideas, instrumentation and computational models of physics to understand living systems. From the molecules within cells to creation of medical technologies, biophysics has an enormous impact on our daily life.

Biophysics is a discipline that bridges and includes both the biological sciences and the physical and chemical explanations of living processes, especially at the cellular and molecular levels.

A wide range of carriers are open to biophysicist because of the breadth of their training. They might work primarily in the laboratory, with computers, teach or become science writer, staff members at colleges, universities, medical or dental schools and health institutes.

6. The attributes of a biophysicist.

The ability to:

1. Apply knowledge of mathematics, physics and chemistry concepts to the solution of complex biological problems.
2. Design and conduct experiments and to analyze and interpret data.
3. Function within multi-disciplinary teams.
4. The professional and ethical responsibilities.
5. Communicate effectively.

6. Attain a good basic knowledge of structural and functional aspects of biological systems at many spatial scales, from DNA (single molecule) to the scale of entire organisms.
7. Connect fundamental ideas about the physical behavior of matter and energy to biological structure and function.
8. Place such ideas into a mathematical framework that provides the basis for quantitative predictions for experiments with living systems.
9. Apply the biophysical knowledge and experience in medical field.
10. Apply the self and long life learning.

7. National Academic Reference Standards (NARS) for Biophysics:

For the biophysics branch, NARS was followed by a NARS characterization where more explanations for the NARS of a specific speciality were introduced.

7.1 Knowledge and understanding of biophysics.

Undergraduate study of biophysics is designed to provide education in depth in the physical sciences in association with an understanding of biological phenomena and its problems , and to provide the background necessary for understanding the sophisticated methods of contemporary biophysical and biomedical research .The biophysics program is best suited for students with keen interest and ability in the physical sciences combined with the desire to explore fascinating and important topics in the life sciences.

Acquiring knowledge *and understanding of:*

1. Protein structures, nucleic acid structure, enzyme mechanisms, the phenomena underlying cellular behavior, excitable phenomena in nerve, muscle and visual cells.
2. Basics of sound waves, photons, odors, flavors, and touches by sense organs and converted it into electrical impulses that provide the brain with information about the external world.
3. Conversion of chemical energy into mechanical force and movement by muscle cells.
4. Fundamentals of Mathematics, physics, chemistry and biology appropriate to the discipline.
5. The lipid barrier in cell membrane impermeable to water soluble molecules selectively transported through its non-polar interior.
6. Application of advanced biophysical Technology.
7. Basics of computer and information technology.
8. Design principles of a process or a system and their application to modeling concept.

7.2 Skills

7.2.1 Intellectual skills.

The ability to:

1. Use principles of biophysics in analyzing signals originated from biological systems.
2. Choose appropriate solution for biophysical problems based on analytical thinking, taking into concern different constraints such as safety, quality, environmental impacts and ethics.
3. Apply appropriate biophysical principles analyze data of system components.
4. Use principles of theories of biophysics to interpret results.
5. Design and apply models based on experimental data derived from biological systems.

7.2.2 Practical and Professional skills.

The ability to:

1. Apply mathematical methods to test, analyze and interpret of experimental results.
2. Use the national standards for laboratory equipments which essential for practice research work.
3. Make a considerable choice and to involve the student in the diverse areas of biophysics through laboratory coursework.
4. Implant comprehensive biophysical knowledge, understanding as well as intellectual skills in research work.
5. Present theoretical and experimental results in understandable forms such as tables and graphs.
6. Prepare reports on tutorial and experimental works.
7. Use computational program packages and tools in laboratory work.

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National Academic Reference Standards (NARS) for Geology and Geophysics

5. Introduction

Geology is the fundamental earth science which attempts an intelligent interpretation of products resulting from the natural processes acting on and in the earth. Earth science based on field observations of the natural environment including surface features, climate, soil, surface waters, underground water, oceans, coasts, subsurface structures, and mineral resources. Geologic phenomena originate deep within the earth's crust, and its hypotheses advanced to explain them must be based entirely upon indirect evidence.

Familiarity with the present earth processes and conditions enables the geologist to reconstruct the sequence of past events and thus to interpret the history of the earth and its inhabitants. In addition it explains the appearance of plant and animal life on the earth on definite order. Interpretation of the earth's history requires knowledge of the materials and structure of the earth, as well as a proper conception of the agencies and processes which continually are altering it.

Geology and Geophysics based on different scientific disciplines among of them: chemistry, physics, mathematics, biology and computer. The earliest earth history deals with the form, size and physical condition of the earth as a planet, and thus the subject matter is closely related to astronomy.

Geologists can find employment in the following: oil and mineral exploration, energy exploration, environmental organizations, regional construction (dams, tunnels), teaching, scientific media. Geophysicists may work in the following jobs: private sectors, industry, scientific research, health and education. Geology and Geophysics graduate may works for governmental agencies, universities, petroleum companies, mining industry, or research institutions.

6 . The attributes of a Geologist

The ability to:

- 1- Learn advanced subjects, and think clearly about earth science related topics.
- 2- Understand hypotheses, new problem aspects and different methods for analyzing data.
- 3- Design and perform geological and geophysical field survey or laboratory investigations.
- 4- Work within multidisciplinary team.
- 5- Work professionally and showing ethical responsibilities.
- 6- Communicate effectively with others.
- 7- Make decisions based on the data acquired in the field and laboratory.

- 8- Know the importance of assessing risks and make good judgments about the risk factors.
- 9- Use advanced and high IT technology.

7. National Academic Reference Standard (NARS) For Geology

For the geology branch NARS are followed by (NARS) characterization where more explanation for the (NARS) of specific specialty are presented;

7.1 Acquiring and understanding of:

Geology graduate must be able to know and understand the;

1. Basics terminology, nomenclature, concepts, theories, laws and classification systems used in Earth Sciences.
2. Methods of interpreting and analyzing Earth Science information.
3. Importance of Earth Sciences to economic and environmental issues.
4. Applicability of Earth Sciences to the industrial field and others.
5. Basics of information technology.
6. The processes which shape the natural world at different temporal and spatial scales and their influence on and by human activities.
7. Issues concerning the availability and sustainability of natural resources.

7.2 Skills

7.2.1 Intellectual skills

The ability to:

- 1- Hypothesize range of ideas to solve different problems.
- 2- Recognize and use the subject-related theories, concepts and principles for fruitful discussions.
- 3- Analyze, synthesize and summarize information critically, including prior researches.
- 4- Integrate the collected data in several lines of evidence to formulate the problem.
- 5- Apply knowledge and understanding to handle familiar and unfamiliar problems.
- 6- Criticize the techniques and theories to recognize the proper applicable techniques or theories.

7.2.2 Professional and Practical skills

The ability to:

- 1- Conduct and present an independent project.
- 2- Present data in a number of formats.
- 3- Investigate prior work and references.
- 4- Use laboratory and field equipment safely either for collecting samples or attached tools.
- 5- Be honest about sample selection, precision and certainty during collection, recording and analysis of data in the field or laboratory.
- 6- Receive and respond to a variety of information sources.

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National Academic Reference Standards (NARS) for Astronomy and meteorology

5- Introduction

Astronomy and meteorology are important subjects in the higher education system and can be demanded in many fields. Geology, Physics, Chemistry, mathematics and biology, can be required to understand some areas of astrophysics. The physics and chemistry involved in these subjects are not simply disciplines for the training of scientific personnel. However, these areas play an important role in our intellectual understanding of all aspects of the universe and its foundation.

Astronomy and meteorology are concerned with the observation, analysis, understanding and prediction of the observed space and climate phenomena. They deal with profound questions about the nature of the universe and with some of the most important practical, environmental and technological issues of our time. Their scope is broad and involves mathematics and theory, experiment and observations, computing, technology, materials and information theory. Physical ideas and techniques from astronomy meteorology also drive developments in related disciplines including chemistry, geology, biology, computing, engineering, material sciences, mathematics, medicine and the life sciences and statistics.

Astronomy and meteorology are working in both theoretical and practical (observational) disciplines that continually evolve. Many advances are clearly shown in the techniques of observations in many of the different bands of electromagnetic radiation. The scientific labs that simulate the physical conditions observed in the natural environment also grow in their sophisticated facilities. All of that helps in growing our ability to understand the details of the natural phenomena as it occurs. Few key quantities such as energy, gravity, radiation and momentum, in addition to some other universal principles, govern the phenomena observed in the space near Earth or in the universe. Part of the appeal of the subject is that there are relatively few such principles and that these apply throughout science and not just in astronomy. The laws of mechanics are a good example; deduced by Newton after studying observations of planetary motion, they govern systems familiar from everyday life as well as many of the phenomena observed in the movement of stars and galaxies.

Most astronomers and meteorologists have strong expertise in areas such as remote sensing, instrumentation, computer applications and spectral observations, so they can work in these fields. They can also work in a number of areas including science museums and planetariums. Astronomers work, also at astronomy university departments, as well as at astronomy observatories.

6- Attributes of Astronomist & Meteorologist

The ability to:

- 1- Effectively use and understand most of the fundamental physical laws and principles, and competence in the application of these principles to their area of study.
- 2- Solve problems in physics using appropriate mathematical tools.

- Identify the relevant scientific principles and make approximations necessary to obtain solutions.
- 3- Execute and analyze critically the results of an experiment or investigation and draw valid conclusions.
 - 4- Evaluate the level of uncertainty in results and compare these results with expected outcomes, theoretical predictions or with published data.
 - 5- Evaluate the significance of their results in the context.
 - 6- Effectively use of appropriate IT packages/systems for the analysis of data and the retrieval of information.
 - 7- Present and interpret information graphically.
 - 8- Use the proper scientific techniques and analysis to model the studied phenomenon.
 - 9- Communicate scientific information and produce clear and accurate scientific reports.
 - 10- Manage his own learning and to make use of appropriate texts, research-based materials or other learning resources.

7- National Academic Reference Standards for the Astronomy & Meteorology Program.

7.1 Acquiring and Understanding of:

- 1- The advanced related topics, develop and investigative experimental, mathematical, computational modeling.
- 2- A broad base knowledge about physics and applied physics.
- 3- The fundamentals, of electromagnetism, quantum and classical mechanics, statistical physics and thermodynamics, wave phenomena and the properties of matter.
- 4- The application of the fundamental principles to particular areas. These may include atomic physics, nuclear and particle physics, condensed matter physics, materials, plasmas and fluids.
- 5- Astronomy and meteorology are quantitative subjects and appreciate the use and power of mathematics for modeling the physical world and solving problems.

7.2 Skills

7.2.1 Intellectual Skills

The ability to:

- 1- Formulate and tackle scientific problems in their area of study.
- 2- Identify the appropriate physical and chemical principles related to the study field.
- 3- Think critically about problems to present solutions and making their explicit assumptions.
- 4- Use appropriate methods to analyze their data and to evaluate the level of its uncertainty.
- 5- Relate any conclusions they make to current theories involved.
- 6- Use mathematics to describe the physical parameters considered in his area of study.
- 7- Manipulate accurate and intricate ideas, to construct logical arguments.

7.2.2 Practical & Professional Skills

The ability to:

- 1- Use the telescope and different equipments to observe some astronomical objects.
- 2- Communicate the results of an experiment (observation) in formal presentation, both oral and written.
- 3- Deal with atmospheric models programs in weather forecasting.
- 4- Execute and report the results of an experiment or investigation.

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National Academic Reference Standards (N A R S) For Biochemistry

5. Introduction

Biochemistry is an advanced, interdisciplinary field that encompasses the biological sciences, chemistry and physics. The aim of biochemistry is the application of the concepts, theories, facts and techniques of both biology and chemistry to the study of living systems and understanding of life's processes in a molecular scale.

The goals of biochemistry are to identify the structure of chemical components and molecules of living cells and to determine the function of each component. It also explores how these components interact and integrate into biological systems as well as how they affect the overall functions of cells and living systems. Biochemistry is also concerned with studying the complex cellular reactions and generation of the energy to power cellular activity, communication and co-ordination between and within cells.

The study of biochemistry provides the concepts, knowledge and principles necessary for biochemist to understand and determine how bio-molecules such as carbohydrates, proteins, nucleic acids, lipids, vitamins and hormones function in such processes. Particular emphasis is placed on regulation of chemical reactions in living cells and the chemical bases of inheritance and disease.

Additionally, biochemistry focuses strongly on a wide range of practical skills required to practice the subject, for example, understanding of the experimental design and the need for proper control of the conditions as well as the standard operation of modern techniques related to the subject area.

A wide variety of subjects is covered through biochemistry study for the bachelor's honors degree. In addition to chemistry, cell biology and macromolecules, molecular biology and molecular genetics are increasing in importance as inter- and intra-cellular signaling. Studies in metabolism, including enzymology, seem to maintain a central place in the biochemistry study.

Besides, other important subjects such as membrane structure including bioenergetics and transport, biological catalysis and bioinformatics are covered. The study of biochemistry includes a degree in single honors in addition to joint degree with other disciplines.

Studying biochemistry facilitates the development of many generic skills, in addition to a great deal of knowledge and practical skills which are essential for varied academic and professional careers. Hence, biochemistry graduates can be employed in different public and private sectors including; research centers (biotechnological, medical, forensic, fishery and agricultural), food and beverage industries, manufacturing and processing, pharmaceutical, health and beauty care organizations, pollution control, hospitals, laboratory services as well as sales representative.

6. The Attributes of a biochemist

The ability to:

1. Posses a good understanding of the molecular basis and the chemistry of the processes that take place in cells and organisms.
2. Posse's basic competencies necessary for a range of practical biochemical techniques and work safely in a laboratory environment.
3. Plan, conduct and evaluate experiments and research, analyze and interpret scientific data.
4. Apply the background knowledge and techniques to solution of biological and industrial problems.
5. Use computing and statistical skills in manipulation and presentation of biochemical data.
6. Work effectively in a team and possess the management and communication skills (both verbally and in written reports).
7. Explore IT skills including data processing and database management for life-long learning and research in particular areas of bio-molecular sciences.

7. National academic reference standards (NARS) for biochemistry:

The academic reference standards represent general expectations about the standards for the award of qualifications at the B.Sc degree in biochemistry and articulate the attributes and capabilities that the graduates should be able to demonstrate.

7.1. Acquiring and understanding

Biochemistry graduate must be able to demonstrate knowledge and understanding of:

1. The fundamentals of sciences relevant to biochemistry such as chemistry, physics and mathematics.
2. The core knowledge of the molecular biosciences, including; biochemical processes, genetics, molecular biology and cell biology, form basics to frontiers of current research.
3. The principles and limitations of practical techniques and methods related to biochemical investigations.
4. The different levels of organization and complexity, from molecules, through cells, organs, to organisms.
5. The structures, assemblies and functions of biological macomolecules and how they conduct and control the biochemical processes.
6. Mechanisms of the key metabolic reactions involved in the biochemical processes and the relation of biochemistry to cellular and organismal processes.
7. The key processes involved in the control of metabolism, including signal transduction as well as the arrangement, expression and regulation of genes.
8. The important biochemical features that distinguish plants from animals.
9. Esthetical issues and the wider implications of scientific biochemical research and the impact of its advances on the society.

7.2. Skills

The biochemistry graduate must be able to demonstrate a wide range of different subject-related skills such as:

7.2.1. Intellectual skills

The ability to:

1. Apply the knowledge and understanding of biochemical and biological principles in solution of familiar problems.
2. Recognize and analyze novel problems, plan and use elements of scientific inquiries for their solution.
3. Select and collect appropriate biochemical informations from a variety of sources, analyze and interpret them quantitatively.
4. Use of computational soft-wares in simulation studies to understand, confirm and optimize the practical techniques.
5. Integrate and link information across different approaches taken in various areas of biochemistry.
6. Evaluate critically the published biochemical information, primary evidences and arguments in particular areas of biochemistry as well as make critical judgments.
7. Formulate and test hypotheses with the minimum of assistance.

7.2.2. Practical and professional skills

The ability to:

1. Use advanced biochemical techniques and methods relevant to the molecular biosciences in a safe, logistical and ethical manner
2. Conduct standard laboratory procedures involved in biochemical analysis and synthetic work as well as industrial applications.
3. Design, plan and conduct experiments, report on the investigation results and discuss the principles behind experimental design.
4. Appreciate variations inherent in dealing with biological materials such as sample size, accuracy, and calibration and precision.
5. Use computational packages and tools in data handling and manipulation as well as the appropriate use of statistics and the different ways of presenting experimental results.

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National Academic Reference Standards (N A R S) For Mathematics

5. Introduction

Is one of the oldest and most fundamental sciences. It constitutes a body of established facts, achieved by a reliable method, verified by practice, and agreed on by a consensus of qualified experts. Mathematicians use mathematical theory, computational techniques, algorithms, and the latest computer technology to solve economic, scientific, engineering, physics, and business problems. The work of mathematicians falls into two broad classes -- theoretical (pure) mathematics and applied mathematics.

Theoretical mathematicians advance mathematical knowledge by developing new principles and recognizing previously unknown relationships between existing principles of mathematics. Although these workers seek to increase basic knowledge without necessarily considering its practical use, such pure and abstract knowledge has been instrumental in producing or furthering many scientific achievements.

Applied mathematicians, on the other hand, use theories and techniques, such as mathematical modeling and computational methods, to formulate and solve practical problems in business, engineering, and the physical, life, and social sciences. Applied mathematicians are frequently required to collaborate with other workers in their organizations to find common solutions to problems.

Adult students entering university mathematics programs today bring a rich diversity of experiences. This diversity challenges educators to define clear goals and standards, develop effective instructional strategies, and present mathematics in appropriate contexts. Institutions, departments, and individual faculty must take active roles in addressing the needs of diverse students, in providing a supportive environment, and in improving curricular and instructional strategies.

Mathematics is offered as a single major program, and also joint with other disciplines, such as statistics and computer science, for double major programs. Graduates of such programs are employed in a wide range of careers in business, education, industry, and government. A large number of these graduates have teaching and research jobs in a variety of educational institutions. In business, industry and government, these graduates, as mathematicians, typically work with other scientists as part of a team, solving a variety of problems, such as translating mathematical problems into computational procedures, or designing mathematical models to predict the behavior of phenomena in a physical or a life science. However, the job titles of these graduates often do not include the word "mathematics" or "mathematician," but do involve significant use of mathematics and reasoning.

6. The attributes of a Mathematician

The ability to:

1. understand, recognize, and describe patterns and make abstractions about them
2. use what they learn to draw conclusions about the natural world
3. find true statements that can be made about mathematical objects
4. apply techniques, tools, and formulas to understand an object's attributes
5. solve problems and build new mathematical knowledge through problem solving
6. recognize and use various types of reasoning and methods of proof
7. communicate effectively, so they can interpret problems and present technical results to people with limited mathematics training
8. recognize and understand how mathematical ideas interconnect and build on one another
9. create and use representations to model and interpret mathematical ideas

7. National Academic Reference Standards (NARS) for Mathematics Programs

The standards have to be building in a framework through which it will be redistributed in performances to satisfy the main aims of the program. The framework of these standards should be consistent with frameworks presented in other mathematics reform initiatives and are intended to affect every aspect of a university mathematics program.

7.1 Acquiring knowledge and understanding of:

1. Performance numerical mathematics, as well as reason and draw conclusions from numerical information.
2. Translation problem situations into their symbolic representations and use those representations to solve problems.
3. Development of spatial and measurement sense.
4. Demonstration and understanding of the concept of function by several means (verbally, numerically, graphically, and symbolically) and incorporate it as a central theme into their use of mathematics.
5. Knowledge of discrete mathematical algorithms and develop combinatorial abilities in order to solve problems of finite character and enumerate sets without direct counting.
6. Analysis of data and use the probability and statistical models to make inferences about real-world situations.
7. The deductive natures of mathematics as an identifying characteristic of the discipline, recognition of the roles of definitions, axioms, and theorems, and identification and construction of valid deductive arguments.

7.2 Skills

7.2.1 Intellectual skills

The ability to:

1. Engage in substantial mathematical problem solving.
2. Learn mathematics through modeling real-world situations.
3. Students will expand their mathematical reasoning skills as they develop convincing mathematical arguments.
4. Engage in meaningful mathematics problems that build connections within branches of mathematics and between mathematics and other disciplines so that students will view mathematics as a connected whole relevant to their lives.

7.2.2 Professional and Practical skills

The ability to:

1. Learn a variety of techniques for solving problems.
2. Develop the view that mathematics is a growing discipline, interrelated with human culture, and understand its connections to other disciplines.
3. Use appropriate technology to enhance their mathematical thinking and understanding and to solve mathematical problems and judge the reasonableness of their results.

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