



Menoufia University
Faculty of Applied Health Sciences Technology
Biomedical Equipment Technology Program



Academic Reference Standards (ARS)

For

Biomedical Equipment Technology Program

B.Sc. Program

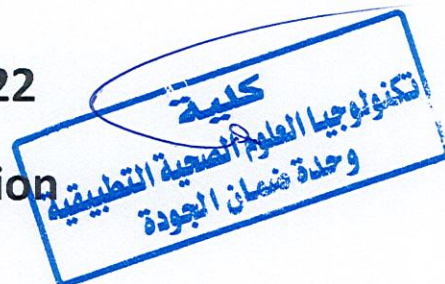
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I. Introduction

The Biomedical Equipment Technology Program at the *Faculty of Applied Health Sciences Technology, Menoufia University* aims to prepare competent graduates who can bridge the gap between health sciences and engineering applications in modern healthcare systems. In response to national and international standards for academic reference frameworks, this Academic Reference Standards (ARS) provides a comprehensive structure that defines the expected knowledge, intellectual capabilities, practical competencies, and transferable skills of graduates in the field of biomedical equipment technology.

Biomedical equipment technologists play a critical role in ensuring the functionality, reliability, and safety of medical devices and systems that are essential to patient care and technical decision-making. The growing integration of digital, electronic, and mechatronic technologies into healthcare requires graduates to possess a multidisciplinary foundation encompassing biomedical sciences, applied engineering, data analytics, and clinical understanding. Therefore, this framework aligns educational outcomes with the rapidly evolving technological landscape of healthcare delivery and supports Egypt's national vision for sustainable development and healthcare innovation.

This Academic Reference Standard (ARS) has been developed in accordance with the Egyptian National Authority for Quality Assurance and Accreditation of Education (NAQAAE) guidelines, while also referencing global best practices in biomedical engineering technology education. It emphasizes the integration of theoretical knowledge with practical experience to ensure that graduates can function effectively across various healthcare environments, including hospitals, diagnostic centers, and research facilities.



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The competency frameworks are structured into five domains that collectively represent the competencies required for professional excellence in biomedical equipment technology as following:

Framework Title	Definition / Purpose
1. Clinical Instrumentation and Patient Care	Ensure graduates can provide safe, effective, and compassionate healthcare through structured assessment, technical decision-making, and evidence-based practice and Instrumentation .
2. Technological Design and Innovation	Integrates engineering, biomedical, and digital technologies to design, implement, and maintain healthcare systems and devices.
3. Diagnostic and Analytical Proficiency	Develops competencies in measurement, imaging, laboratory testing, calibration, and data interpretation for clinical and research contexts.
4. Quality, Ethics, and Professional Practice	Promotes professional conduct, patient safety, infection control, and adherence to ethical and legal standards in healthcare environments.
5. Research, Leadership, and Lifelong Learning	Encourages continuous improvement, scientific inquiry, leadership, and effective communication within multidisciplinary teams.

Through these integrated domains, the program ensures that graduates are well-prepared to contribute to the design, management, and advancement of biomedical technologies that enhance patient safety, healthcare quality, and technological innovation. The ARS thus serves as a foundational reference for curriculum development, quality assurance, and continuous improvement in biomedical equipment technology education.

In this competency framework for the Biomedical Equipment Technology program, the ECG wave letters P, Q, R, S, and T are used symbolically to represent the five core competency



domains. Each letter corresponds to a specific domain in order: P represents Clinical Instrumentation and Patient Care, reflecting the foundational skills in patient assessment and care delivery; Q represents Technological Design and Innovation, highlighting the ability to develop and implement biomedical technologies; R represents Diagnostic and Analytical Proficiency, emphasizing proficiency in measurements, analysis, and interpretation; S represents Quality, Ethics, and Professional Practice, underscoring adherence to professional, ethical, and safety standards; and T represents Research, Leadership, and Lifelong Learning, capturing skills in scientific inquiry, leadership, teamwork, and continuous professional development. This analogy illustrates how each domain, like each ECG wave, contributes to the integrated and sequential development of competent graduates.

II. Adopted Methodology

The Academic Reference Standards (ARS) for the Biomedical Equipment Technology Program were developed following a systematic, evidence-based, and academically rigorous methodology, ensuring alignment with national accreditation requirements, international best practices, and the evolving needs of healthcare technology. The methodology involved the following stages:

1. Brainstorming and Initial Planning

- A preliminary brainstorming session was conducted with faculty members, program coordinators, and key stakeholders to identify the scope, objectives, and intended outcomes of the ARS.
- This step facilitated the identification of core competencies, emerging trends in biomedical technology, and critical skills required for graduates in modern healthcare environments.



2. Comprehensive Review of National and International Standards

- Development was grounded in the National Academic Reference Standards (NARS) for Engineering (2018) for technical and engineering competencies.
- NARS for Medicine (2017) was consulted to integrate essential clinical, patient-centered, and ethical competencies.
- NARS for Basic Sciences (2009) provided foundational knowledge in physics, chemistry, and biology necessary for biomedical engineering.
- International best practices in biomedical engineering and healthcare technology education were also reviewed to ensure the ARS incorporates emerging technologies, innovative practices, and global standards.

3. Definition of Graduate Attributes and Competency Domains

- Graduate attributes were defined to include knowledge, practical skills, professional behavior, ethical standards, and transferable skills.
- Competencies were organized into five integrated domains reflecting the interdisciplinary nature of biomedical equipment technology:
 - Clinical Instrumentation and Patient Care
 - Technological Design and Innovation
 - Diagnostic and Analytical Proficiency
 - Quality, Ethics, and Professional Practice
 - Research, Leadership, and Lifelong Learning
- This framework ensures graduates acquire the technical, clinical, ethical, and leadership skills required for modern healthcare environments.



4. Mapping Competencies to Intended Learning Outcomes (ILOs)

- Each competency within the five domains was explicitly linked to intended learning outcomes, specifying the expected knowledge, skills, and attitudes of graduates.
- This mapping ensures alignment between ARS, curriculum content, instructional strategies, and assessment methods, supporting measurable and observable learning achievements.

5. Stakeholder Consultation and Validation

- Draft ARS were reviewed by faculty members, clinical practitioners, biomedical engineers, industry experts, and regulatory authorities.
- Stakeholder input ensured that the competencies are relevant, practical, and aligned with labor market and healthcare system needs.
- Feedback was systematically incorporated to enhance clarity, coherence, and applicability.

6. Iterative Refinement

- The ARS underwent multiple cycles of review and revision, ensuring internal consistency, elimination of overlaps, and compliance with NAQAAE accreditation standards.
- This iterative process guarantees that the ARS is robust, comprehensive, and adaptable to future technological advancements and healthcare trends.

7. Dissemination

- The finalized ARS was communicated and shared with all relevant stakeholders, including faculty, clinical partners, industry representatives, and accreditation bodies.
- Dissemination ensures awareness, understanding, and adoption of the ARS across teaching, learning, and professional practice contexts.



8. Documentation and Standardization

- The ARS was documented in a structured and standardized format, including competency domains, detailed competencies, associated learning outcomes, and graduate attributes.
- This ensures a transparent, evidence-based framework to guide curriculum design, quality assurance, assessment, and continuous improvement of the program.

9. Endorsement of Standards

- The ARS underwent formal approval and endorsement by the Faculty Board, program committees, and relevant accreditation authorities.
- Endorsement confirms that the standards are official, credible, and recognized as the benchmark for graduate competencies and program quality assurance.

III. Prospective Employers for Graduates

Graduates of the Biomedical Equipment Technology Program acquire a multidisciplinary set of skills combining biomedical sciences, engineering, instrumentation, diagnostics, and healthcare technology management. This prepares them for employment in diverse healthcare, industrial, and research settings. The prospective employers include:

1. Hospitals and Healthcare Facilities

- Clinical engineering departments, biomedical equipment maintenance units, diagnostic imaging centers, and patient care technology services.

2. Medical Device and Equipment Companies

- Design, manufacturing, calibration, and quality assurance of medical devices and biomedical systems.



3. Healthcare Technology Service Providers

- Companies offering installation, maintenance, and technical support for medical and laboratory equipment.

4. Research and Development Centers

- Academic, industrial, or clinical research labs focusing on medical device innovation, instrumentation, and biomedical engineering solutions.

5. Government and Regulatory Agencies

- Ministry of Health, public health laboratories, medical standards authorities, and equipment safety inspection units.

6. Educational and Training Institutions

- Universities, technical colleges, and training centers providing instruction or workshops on biomedical equipment technology.

7. Consultancy and Health Technology Management Firms

- Organizations providing advisory services, risk assessment, hospital technology planning, and equipment lifecycle management.

Graduates are thus well-prepared to contribute effectively to the operation, maintenance, innovation, and management of biomedical technologies, supporting patient safety, healthcare quality, and technological advancement across multiple sectors.

IV. Attributes of the Graduates

Graduates of the Biomedical Equipment Technology Program at Menoufia University are envisioned to be competent, innovative, ethically responsible professionals capable of integrating health sciences with advanced engineering technologies to serve the evolving needs



of modern healthcare systems. Upon completion of the program, graduates are expected to demonstrate the following key attributes:

IV.1 General Graduate Attributes:

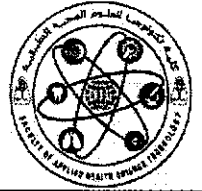
The graduates of the Biomedical Equipment Technology program must be able to:

- (1) Possesses comprehensive scientific knowledge and the ability to understand and apply engineering principles in diverse contexts.
- (2) Able to analyze problems and develop innovative solutions that support scientific and technological advancement.
- (3) Adheres to professional and ethical standards and applies them to ensure quality and reliability in practice.
- (4) Demonstrates effective communication, leadership, and teamwork skills in multidisciplinary environments

IV.2 Program-Specific Attributes

The graduates of the Biomedical Equipment Technology program must be able to:

- (1) Operate, calibrate, and maintain biomedical equipment, diagnose technical malfunctions, and ensure reliable clinical performance.
- (2) Design, develop, and enhance biomedical and electronic systems by applying smart control and monitoring technologies.
- (3) Comply with national and international standards, codes, and regulations while adhering to ethical and legal responsibilities in biomedical practice.
- (4) Support and apply scientific research and technological innovation to deliver creative, evidence-based solutions in healthcare technology



V. Academic Reference Standards (ARS) for Biomedical Equipment Technology Program

The competency frameworks for the Biomedical Equipment Technology program are structured to ensure graduates acquire the essential knowledge, skills, and professional attributes required for excellence in the field. These frameworks are organized into five interconnected domains: Clinical Instrumentation and Patient Care, Technological Design and Innovation, Diagnostic and Analytical Proficiency, Quality, Ethics, and Professional Practice, and Research, Leadership, and Lifelong Learning. Each domain encompasses a set of carefully defined competencies that collectively prepare students to integrate engineering, biomedical, and clinical sciences effectively in healthcare settings.

The competencies have been meticulously mapped to the five domains to avoid overlap and ensure clarity, relevance, and balance. This mapping provides a clear link between the expected learning outcomes, professional standards, and real-world applications in biomedical technology. Graduates who achieve these competencies are expected to demonstrate safe, innovative, and evidence-based practice, contribute to technological advancement in healthcare, uphold ethical and professional standards, and engage in continuous learning and leadership. This structured approach not only guides curriculum development and assessment strategies but also supports accreditation, quality assurance, and alignment with national and international standards for healthcare technology education.

A detailed presentation of each competency framework along with its associated competencies, highlighting the specific learning outcomes expected of graduates are provided as following:



1. Clinical Instrumentation and Patient Care (P)

Graduates of the Biomedical Equipment Technology program must demonstrate comprehensive knowledge and practical competence in delivering safe, patient-centered care, performing structured clinical Instrumentation assessments, and applying evidence-based decision-making in diverse healthcare settings. The graduates must be able to:

P1 Interpret device-generated physiological data to identify abnormal readings or equipment malfunctions, and communicate findings effectively within multidisciplinary teams, escalating critical issues to ensure timely and safe responses.

P2 Apply biomedical and clinical sciences to evaluate, interpret, and manage health-related problems within authentic and diverse clinical contexts.

P3 Decide appropriate technical and clinical actions by interpreting device performance and relevant medical data using information technologies and evidence-based methods, and escalate clinical concerns to the medical team to ensure timely and safe decision-making.

P4 Provide appropriate technical support during emergencies by ensuring the correct operation, rapid troubleshooting, and readiness of biomedical devices and life-support systems, while contributing to a safe and dignified care environment for patients."

P5 Ensure the safe, reliable, and effective operation of biomedical devices by prioritizing and escalating alarms appropriately, adhering to electrical, mechanical, and environmental safety standards, and applying thorough knowledge of device indications and contraindications to support precise monitoring, operation, and maintenance.



P6 Adapt biomedical technologies and clinical instrumentation to accommodate diverse user needs and varying levels of functional ability, ensuring safe, accessible, and effective device utilization across different healthcare contexts.

P7 Promote public and community health by identifying technology-related determinants of health, supporting preventive and educational initiatives, and utilizing biomedical and digital-health technologies to enhance awareness, empower individuals, and provide reliable solutions for effective health monitoring and management.

2. Technological Design and Innovation (Q)

Graduates must demonstrate the ability to design, implement, and optimize innovative, sustainable, and integrated biomedical technologies that meet clinical, ethical, and societal requirements. The graduates of the Biomedical Equipment Technology program must be able to:

Q1 Analyze, Design and implement sustainable, innovative, and cost-effective solutions that integrate biomedical requirements with electrical, electronic, and mechatronic technologies, consistent with social, environmental, and ethical responsibilities.

Q2 Model, analyze, and evaluate biomedical and digital systems relevant to healthcare applications by employing appropriate engineering principles, electronic design methods, and computational tools.

Q3 Utilize contemporary tools, technologies, and professional standards in both healthcare and engineering practices to optimize performance, efficiency, and safety against device-related risks.



Q4 Design and implement integrated healthcare technologies that combine electronic, mechatronic, and digital components to effectively support diagnostic, monitoring, and therapeutic functions.

Q5 Participate in the design, development, and optimization of biomedical systems and devices that meet the functional and technical biomedical needs of modern healthcare services.

Q6 Identify key determinants affecting user needs and incorporate principles that support overall health and risk mitigation into the design and optimization of biomedical devices and technological solutions, enhancing usability, functionality, and user engagement.

Q7 Apply intelligent control and monitoring technologies in automated medical systems to enhance accuracy, functionality, and patient safety.

3. Diagnostic and Analytical Proficiency (R)

Graduates must demonstrate proficiency in performing, analyzing, and interpreting biomedical and clinical measurements, ensuring accuracy, reliability, and quality in diagnostic processes. The graduates of the Biomedical Equipment Technology program must be able to:

R1 Solve complex and multidisciplinary problems in health sciences and biomedical technologies by effectively applying advanced principles of mathematics, physics, programming, data analysis, system modeling, and critical thinking.

R2 Measure and evaluate the performance, accuracy, and reliability of systems intended for medical and healthcare applications using suitable instruments and analytical techniques.



R3 Perform biomedical and clinical measurements using validated and certified medical instruments and accurately analyze results to contribute to reliable and timely technical outputs that support clinical diagnoses.

R4 Calibrate, adjust, and operate medical devices in accordance with clinical procedures, manufacturer guidelines, and recognized quality and safety standards within healthcare environments.

R5 Diagnose technical malfunctions and apply appropriate maintenance strategies to ensure continuous operation, reliability, and clinical readiness of medical equipment.

R6 Evaluate the performance, efficiency, and compliance of medical devices, and prepare detailed technical documentation to inform clinical and managerial decision-making.

4. Quality, Ethics, and Professional Practice (S)

Graduates must demonstrate a commitment to patient safety, ethical and legal standards, risk management, and professional integrity in all healthcare and engineering practices. The graduates of the Biomedical Equipment Technology program must be able to:

S1 Demonstrate professional integrity, ethical decision-making, and accountability in all activities, maintaining appropriate professional boundaries and ethically handling sensitive clinical environments while ensuring compliance with guidelines, policies, and best practices.

S2 Ensure patient safety and high-quality care by implementing effective risk management strategies, infection control protocols, and adherence to professional, legal, and ethical standards in all clinical and technical operations, including timely and accurate incident reporting to address risks and prevent recurrence.



S3 Apply national and international codes, standards, and regulatory frameworks in the design, development, evaluation, and maintenance of biomedical equipment and healthcare systems.

S4 Implement and monitor quality assurance processes in biomedical and healthcare technology, continuously evaluating system performance, safety, and effectiveness to drive sustainable improvements.

S5 Reinforce evidence-based quality assurance practices by ensuring the accurate calibration of biomedical devices, maintaining detailed maintenance and inspection logs, and systematically applying QA protocols to guarantee safe, reliable, and effective device operation, including thorough documentation of all activities and procedures.

5. Research, Leadership, and Lifelong Learning (T)

Graduates must demonstrate skills in research, data interpretation, leadership, teamwork, and continuous professional development to advance healthcare technology practice. The graduates of the Biomedical Equipment Technology program must be able to:

T1 Conduct scientific research using appropriate methodologies, analyze and interpret biomedical data accurately, and apply evidence-based practices to improve healthcare technology performance.

T2 Demonstrate effective leadership by managing tasks, coordinating multidisciplinary teams, and making informed decisions that enhance productivity, safety, and quality within healthcare technology environments.



T3 Apply principles of scientific inquiry and technological innovation to design creative, practical, and sustainable solutions that address challenges in biomedical equipment and clinical technology systems.

T4 Engage in continuous learning through self-assessment, adherence to ethical and regulatory standards, and adoption of emerging technologies to maintain professional competence and support organizational improvement.

VI. Curriculum Structure

The following table summarizes the distribution of the Biomedical Equipment Technology curriculum across the five core competency frameworks, indicating the relative emphasis of each area. This allocation ensures graduates develop balanced expertise in Clinical Instrumentation and Patient Care, Technological Design and Innovation, Diagnostic and Analytical Proficiency, Quality, Ethics, and Professional Practice, and Research, Leadership, and Lifelong Learning, aligned with program outcomes and professional standards. The percentages mentioned in the following table for each area of study is just a guide for faculties of health sciences technology and not obligatory to follow.

Subject Areas	Range (%)
1. Clinical Instrumentation and Patient Care	20 – 25 %
2. Technological Design and Innovation	25 – 30 %
3. Diagnostic and Analytical Proficiency	15 – 20 %
4. Quality, Ethics, and Professional Practice	10 – 15 %
5. Research, Leadership, and Lifelong Learning	15 – 20 %



VII. Glossary

The following glossary provides definitions of key terms and concepts used throughout the Biomedical Equipment Technology competency framework. It serves as a reference to ensure clarity, consistency, and shared understanding among faculty members, students, and stakeholders. The glossary defines the technical, clinical, analytical, and professional terms that underpin the program's learning outcomes and competency domains. By standardizing terminology, this section supports accurate interpretation of the competencies, facilitates and enhances the overall quality and transparency of the educational framework.

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. Attributes of the Graduates

Competencies expected from the graduates 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 what can be expected of a graduates 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. Clinical Instrumentation and Patient Care:

A domain concerned with the safe and effective use of biomedical equipment within patient care environments, applying clinical instrumentation skills to interpret device-generated data, ensure equipment readiness, and support clinical teams, while maintaining patient safety, high-quality care, evidence-based practice, and adherence to ethical and professional standards.

9. Technological Design and Innovation:

A domain focuses on developing and applying innovative technological solutions in healthcare. It includes creative problem-solving through design thinking, prototyping, and



system integration to improve medical devices, enhance diagnostic and therapeutic systems, and support sustainable and efficient healthcare technology development.

10. Diagnostic and Analytical Proficiency:

A domain centers on the accurate collection, analysis, and interpretation of data to support clinical and technical decisions. It includes maintaining diagnostic accuracy, performing instrument calibration, applying quality control procedures, and utilizing analytical skills to ensure reliable results and effective problem-solving in healthcare environments.

11. Quality, Ethics, and Professional Practice:

A domain promotes adherence to ethical principles, professional behavior, and quality standards in healthcare and technology. It emphasizes accountability, confidentiality, regulatory compliance, and continuous quality improvement to ensure safe, responsible, and effective professional practice aligned with institutional and societal expectations.

12. Research, Leadership, and Lifelong Learning:

A domain encourages engagement in research, leadership, and continuous learning to enhance professional competence and innovation. It involves applying research methods ethically, demonstrating leadership and teamwork, and committing to lifelong learning as essential elements of personal and professional development in a rapidly evolving healthcare field.



VIII. References

1. National Authority for Quality Assurance and Accreditation of Education (NAQAAE). (2018). *National Academic Reference Standards for Engineering (NARS 2018)*. Cairo, Egypt.
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