ASEAN FRAMEWORK ON THE EXCHANGE OF INFORMATION IN PROMOTING ADAPTION AND QUALIFICATIONS:

CHEMICAL ENGINEERING IN THE PHILIPPINES

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Introduction

Chemical Engineering refers to a discipline at the interface of molecular sciences and engineering closely linked with the fundamental subjects of chemistry, biology, mathematics, physics and the application of computational science and collaborative with other engineering disciplines to design equipment, systems, and processes, to operate an industrial plant, and manufacture products.

Chemical Engineering is the branch of engineering that deals with turning raw materials into valuable products. It involves the design, operation, and optimization of processes that chemically change materials, producing things like fuels, plastics, pharmaceuticals, and even food. Chemical engineers use principles from chemistry, physics, math, and biology to create efficient, safe, and sustainable manufacturing methods.

Chemical Engineering is absolutely crucial to nation-building. By turning raw materials into valuable products like fuels, pharmaceuticals, and food, chemical engineers help drive economic growth and improve quality of life. They're at the forefront of developing sustainable technologies that can address environmental challenges. Think clean energy, waste management, and pollution control. It's like having a mix of economic prosperity, healthcare advances, and environmental stewardship, all powered by chemical engineering.

Chemical Engineering's importance in education is profound. It equips students with problem-solving skills, critical thinking, and innovation. It integrates chemistry, physics, math, and biology, creating a multidisciplinary approach that's essential for addressing complex real-world challenges. Whether designing sustainable processes, developing new materials, or improving environmental safety, chemical engineering education prepares future leaders to make impactful contributions to society. It's like being handed the keys to a toolset that can shape a better world.

Chemical Engineering's role in government is huge. Governments need chemical engineers to develop and enforce regulations for public health, safety, and the environment. They're essential for policy-making around sustainable energy, waste management, and industrial processes. Chemical engineers also work on national infrastructure projects, ensuring clean water and air, and advancing healthcare technologies. It's a partnership that fuels progress, innovation, and public well-being. It's like a constant balance of industrial growth and environmental responsibility.

The **History of Chemical Engineering** in the Philippines is quite fascinating! It dates back to the early 20th century. The roots can be traced to the University of the Philippines College of Agriculture (UPCA), which established a Sugar Technology Program in 1920 to support the growing Philippine sugar industry. This program trained students in cane production, sugar chemistry, and factory operations.

The first licensure examination for Chemical Engineers was administered on July 1937 through the Civil Service Commission. The Board Examiners were composed of the Chairman: Engr. Angel S. Arguelles and Members: Engr. Rafael H. Aguilar and Engr. Ramon J. Feliciano. The Office of Board of Examiners was under the Civil Service Commissioner until the creation of PRC on June 22, 1973.

As early as 1938, Filipino technical men in industry, realizing the need for stimulating the members of a young profession to the needs of industrialization in our country, envisioned an association of chemical engineers. In 1939, the Philippine Institute of Chemical Engineers, otherwise known as "PIChE" for short, was formally an organization whose members were, to mention a few, Rafael Aguilar, Angel S. Argueles, Amando Clemente, Timoteo T. Dar Juan, Felix V. Espino, Ramon T. Feliciano, Roque Garcia, Vicente Lava, Benito Legarda, Moises Lucas and Francisco Quisumbing. They formed a cohesive group of chemists and chemical engineers geared to meet the challenge of industrialization.

In 1939, the Philippine Institute of Chemical Engineers (PIChE) was formed to promote the profession and address the needs of industrialization in the country. The PIChE was inaugurated in 1939 at the National Development Company. Mr. Jose C. Espinosa, one of the early chemical engineering graduates from the Massachusetts Institute of Technology, was installed as the first president of the Institute by Dr. Manuel Roxas. Dr. Timoteo T. Dar Juan, being the oldest among the Institute members, administered the oath of office. The other officers were Dr. Vicente Lava, 1st vice president; Moises Lucas, secretary; Roque Garcia, treasurer, and Isaac L. Santos, auditor. The board of directors included Dr. Angel S. Arguelles, Dr. Amando Clemente, Dr. Timoteo T. Dar Juan, Felix V. Espino, Dr. Ramos Feliciano and Benito Legarda.

In 1940, when Engr. Felix V. Espino was elected president, a notable event was the arranged, a lecture sponsored by the institute on April 15, 1939, at the Philippine Columbian Clubhouse. Col. Frederick Pope, A.I.Ch.E., a pioneer in dye manufacture, was guest speaker on the subject, "Ammonia Synthesis."

In 1941, Mr. Jose Espinosa was elected for the second time. World War II interrupted the Institute activities and inevitably claimed the lives of number of prominent members among who were Lt. Pacifico Rementilla, Dr. Timoteo T. Dar Juan, Moises Lucas, Victor Perez and Gilberto Ruiz.

Peace came eventually and the members of the Institute, eager to reorganize, enthusiastically restored the Institute on its feet. Mr. Felix V. Espino was elected president in 1946. The officers and members of the board of directors slowly put together the scattered remnants of the organization. These men included Dr. Ramon T. Feliciano, Vice –President; Benjamin R. Salonga, Secretary; Alfredo Villa – Abrille, Treasurer; and Dr Felipe T. Ardriano, Dr. Angel S. Arguilles, Dr. Amando Clemente and Prof. Jose C. Espinosa, as Directors.

Through Engr. Felix V. Espino's efforts, a chemical engineering bill was presented in Congress. The bill, approved as Republic Act No. 318, is better known as the Chemical Engineering Law. For the first time in Philippine History, the field of practice of chemical engineering was clearly defined. RA 318 was signed into law on June 19, 1948. This law formalized the creation of the Board of Examiners for Chemical Engineering whose members are appointed by the Secretary of Public Works and Communications. Certificates of Registration were issued to Chemical Engineers who pass the board examinations. This law was repealed in 2004 upon the passage of RA 9297, The Chemical Engineering Act of 2004.

The first educational institutions in the Philippines to offer Chemical Engineering Program were Mapúa University and University of Santo Tomas in 1934. Adamson University offered the program in 1935 followed by the De la Salle University in 1947. Other educational institutions all over the country started to offer the program in the next years.

The chemical industry in the Philippines is diverse and plays a crucial role in sectors like agriculture, electronics, food processing, healthcare, and national defense. It's a testament to how chemical engineering has been integral to the country's development and industrial growth. Early industries established in the country were:

1951 – Construction of Caltex Refinery at San Pascual, Batangas
1961 – Petron Bataan Refinery inauguration
1962 – Shell Refinery at Tabangao, Batangas started operations
1967 – Mabuhay Vinyl Corporation Plant in Iligan City was built
1968 - Surigao Nickel Refinery was built

1979 – Mabuhay Vinyl Corporation Diaphragm Cell Plant was built
1983 – PASAR Plant Complex was completed
1984 – PhilPhos Plant was completed
1986 – Surigao Nickel Refinery

Other manufacturing industries were established in the country with chemical engineers occupying significant roles in management and operations.

Educational Pathways

Getting into chemical engineering generally starts with a **Bachelor of Science in Chemical Engineering (BSChE)**. This undergraduate degree lays the foundation in chemistry, physics, biology, and mathematics in relation to the chemical engineering principles. It's a mix of classroom learning and hands-on laboratory work.

Currently, all higher educational institutions offering the BS Chemical Engineering Program need to meet the minimum requirements issued by the Commission on Higher Education (CHED) through CMO 91 series of 2017, the Policies, Standards and Guidelines for BS Chemical Engineering which was formally started in 2018. This requires implementation of an outcomes-based education leading to competency-based standards.

Higher Educational Institutions offering the BS Chemical Engineering Program in the Philippines include:

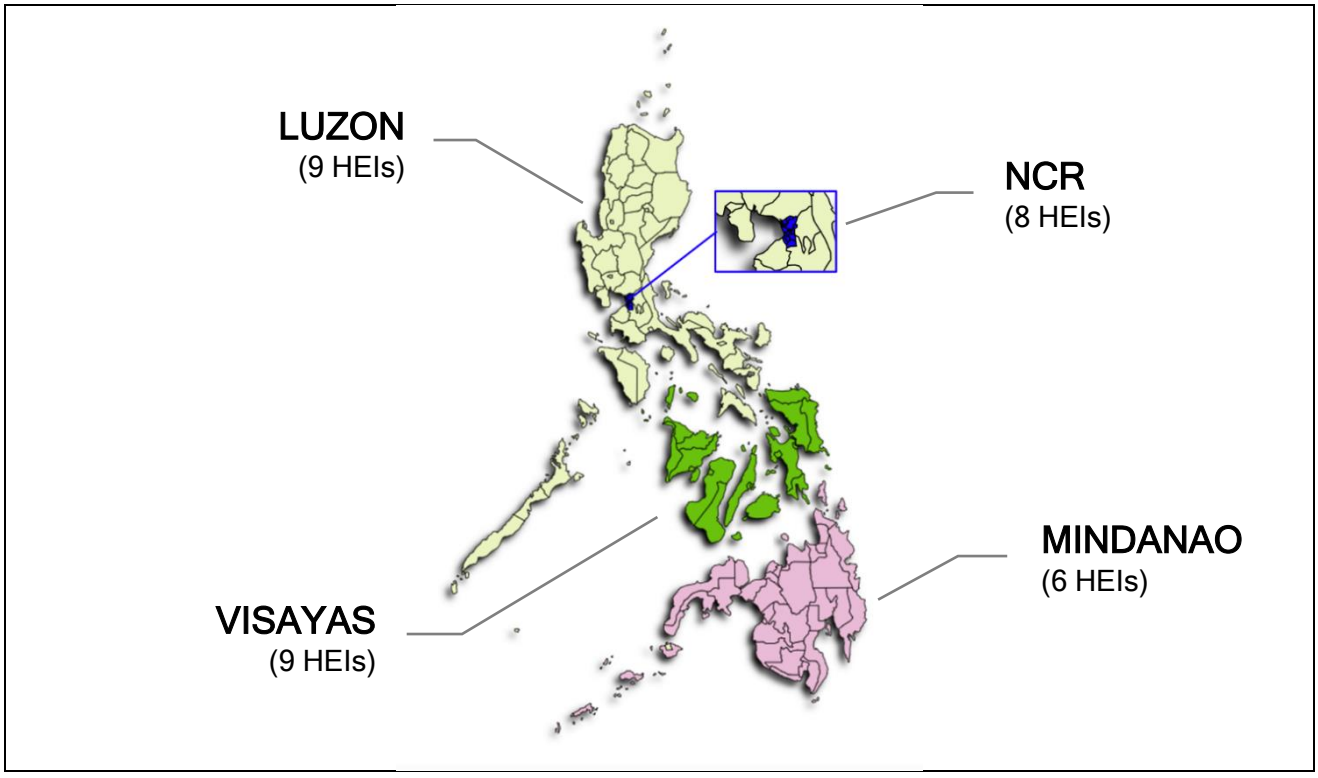
1. National Capital Region (NCR)
   - Adamson University
   - Mapúa University
   - De La Salle University (DLSU)
   - Eulogio “Amang” Rodriguez Institute of Science & Technology (EARIST)
   - Pamantasan ng Lungsod ng Maynila (PLM)
   - Technological Institute of the Philippines-Manila
   - University of Santo Tomas (UST)
   - University of the Philippines Diliman (UPD)

2. Luzon
   - Batangas State University
   - Bicol University (BU) - Legazpi City, Albay
   - Cagayan State University (CSU)
   - Mapua Malayan Colleges Laguna
   - Mariano Marcos State University (MMSU)
   - Saint Louis University (SLU)
   - Dr. Emilio B. Espinosa Sr. Memorial State College of Agriculture and Technology

- University of the Philippines Los Baños (UPLB)

3. Visayas
   - Cebu Institute of Technology University
   - Central Philippine University
   - Colegio San Agustin- Bacolod
   - Eastern Visayas State University
   - University of Negros Occidental-Recoletos (UNO-R)
   - University of the Philippines Visayas (UPV)
   - University of San Agustin
   - University of San Carlos (USC)
   - University of St. La Salle (USLS)

4. Mindanao
   - Ateneo de Davao University
   - University of Mindanao (UM)
   - Mapua Malayan Colleges- Mindanao
   - Mindanao State University - Iligan Institute of Technology
   - Mindanao State University (MSU) - Marawi City, Lanao del Sur
   - Xavier University- Ateneo de Cagayan



Admission requirements for a Bachelor of Science in Chemical Engineering (BSChE) can vary slightly between institutions, but generally, they include:

1. **High School Diploma** - A high school diploma or equivalent is required.
2. **Entrance Exams** - Some universities require entrance exams like the UPCAT (University of the Philippines College Admission Test) for UP schools or other specific entrance tests for other universities.
3. **Academic Records** - Submission of Form 138 (High School Report Card) and other academic records.
4. **Recommendation Letters** - Letters from high school teachers or guidance counselors.
5. **Birth Certificate** - A certified true copy of the NSO (National Statistics Office) birth certificate.
6. **Medical and Dental Records** - Recent medical and dental health records.
7. **Good Moral Character** - A certificate of good moral character.
8. **Application Form** - A completed application form specific to the university.
9. **ID Pictures** - Two 2x2 ID pictures.
10. Application Fee - Payment of an application fee or down payment.

After the bachelor's degree, students can pursue a Master of Science (MS) or Master of Engineering (MEng) in Chemical Engineering. These programs delve deeper into specialized areas and often include research components.

For those wanting to go even further, there's the Doctor of Philosophy (PhD) in Chemical Engineering. This degree is heavily research-focused and prepares graduates for careers in academia, research, and high-level industry positions.

Besides the formal education route, there are also certification programs and professional development courses for ongoing learning and specialization in areas like process safety, environmental engineering, and biotechnological processes.

Regulatory Framework

The practice of the Chemical Engineering Profession is governed by **Republic Act 9297 The Chemical Engineering Act of 2004**. This was signed into law by then Philippine President Gloria Macapagal Arroyo during the 12th Congress Third Regular Session on May 13, 2004. This law repealed R.A. 318.

Highlights of this law include the updated and defined Scope of Practice of the Chemical Engineers, the Chemical Engineer's Dry Seal, the Code of Technical Standards for Chemical Engineers, the membership of newly licensed Chemical Engineers into PIChE and the provisions on the Board of Chemical Engineering for licensure and regulation of the Chemical Engineering Profession.

The Implementing Rules and Regulations (IRR) for RA 9297 was prepared in consultation with PIChE and took effect on November 17, 2004.

All licensed Chemical Engineers are also bound by the Code of Ethics. A Code of Ethics was initially prepared by the Professional Standards and Ethics Committee, was presented to the 1960 annual convention. It was approved and adopted as the Code of Ethics for Chemical Engineers in the same convention.

A new Code of Ethics was published on March 30, 2009 and took effect on April 15, 2009. The revisions on the Code of Ethics were recommended by the PIChE College of Fellows committee headed by Engr. Evelio Echavez. The revised code incorporated the amended laws that apply to the practice of the Chemical Engineering Profession.

All licensed Chemical Engineers are presumed to be law-abiding citizens and should be well aware of the local and national regulations. Concern for the society and the environment should always be considered a priority when applying chemical engineering principles in faced with challenges related to work.

Foreign chemical engineers are issued special permit to practice after submission of documents to the Professional Regulatory Board of Chemical Engineering. The issuance of the permit applies only to non-holders of a Philippine Passport and shall be decided on by the PRB based on the merits of the application for the special permit.

Licensure Examinations for Chemical Engineering are administered twice a year based on a schedule arranged thru the Professional Regulation Commission. The PRB ChE prepares the items to be included in the database for the three days based on the approved Table of Specifications.

Consistent with the provisions of RA 9297, the topics shall cover Physical and Chemical Principles (30%), Chemical Engineering Principles (40%) and General Engineering (30%). To pass the licensure examinations, it requires a minimum average of 70% for the three days with no grade lower than 50% on any day.

All applicants for licensure examinations are required to submit the necessary documents before the set deadline for application. Once the application is accepted and approved, the applicant will be included in the list of examinees and will be designated an examination room. The examinations shall be carried out at duly identified and accredited testing centers.

As of **November 2024, a total of thirty-eight thousand seven hundred seventy eight (38,778)** have passed the Licensure Examinations and are registered Chemical Engineers in the Philippines.

The **Professional Regulation Commission** coordinates all arrangements in relation to the conduct of licensure examinations thru the different divisions under the organizational structure.

1. The Test Development Division handles coordination with the PRB on activities which include the peer review, encoding of items, extraction of test questions, printing of exam questions and item analysis.
2. The Licensure Division arranges the testing centers and conducts the examination including all documentation requirements and secure arrangements for transfer of examination documents.
3. The Ratings Division receives all examination documents, checks for completeness of documents, handles checking of answer sheets, coordinates with PRBs on generating the exam results and prepares official documents for release of results.
4. The Information and Communications Technology Service uploads and releases the examination results.

The successful examinees will be issued the Certificate of Registration and Professional Identification Card after taking their oath as professionals.

The professional Chemical Engineer has to be aware of different issuances coming from **Relevant Government Agencies**:

1. The **Department of Environment and Natural Resources (DENR)** in the Philippines has issued several Department Administrative Orders (DAOs) related to:

   a. **Hazardous Waste Management**
      i. DAO 1992-29: Implementing Rules and Regulations of Republic Act 6969 (An Act to Control Toxic Substances and Hazardous and Nuclear Wastes)
      ii. DAO 2004-36: Procedural Manual for Title III of DAO 92-29 (Hazardous Waste Management)
      iii. DAO 2013-22: Revised Procedures and Standards for the Management of Hazardous Wastes. This order revises DAO 2004-36 and provides updated guidelines for managing hazardous wastes
      iv. DAO 1997-28: Interim Guidelines for the Importation of Recyclable Materials Containing Hazardous Substances
      v. DAO 1994-28: Interim Guidelines for the Importation of Recyclable Materials Containing Hazardous Substances

   b. **Wastewater Management**
      i. DAO 2016-08: Water Quality Guidelines and General Effluent Standards of 20161. This order sets the standards for wastewater discharge to protect water quality.
      ii. DAO 2021-19: Updated Water Quality Guidelines (WQG) and General Effluent Standards (GES) for Selected Parameters. This order revises the previous standards and includes updated guidelines for selected parameters.
      iii. DAO 2005-10: Revised Water Quality Guidelines and General Effluent Standards of 20054. This order provides guidelines for the management of wastewater and effluent standards

   c. **Air Quality Management**
      i. DAO 2000-81: Implementing Rules and Regulations for Republic Act 8749 (The Philippine Clean Air Act of 1999). This order sets the framework for air quality management and pollution control in the country.

ii. DAO 2013-13: Establishing the Provisional National Ambient Air Quality Guideline Values for Particulate Matter 2.5 (PM2.5). This order sets the guideline values for PM2.5 to protect public health.
iii. DAO 2020-14: Establishing the Breakpoints for Particulate Matter 2.5 (PM2.5) Air Quality Index (AQI) and Amending Section 5(a) of DAO 2013-136. This order provides the AQI breakpoints for PM2.5 and their corresponding cautionary statements for the general public

d. Solid Waste Management
   i. DAO 1998-49: Technical Guidelines for the Upgrading of Disposal Systems for Municipal Solid Waste (MSW). This order provides technical norms, environmental quality requirements, and operational performance standards for MSW disposal systems.
   ii. DAO 1998-50: Adopting the Guidelines for the Establishment and Operation of Materials Recovery Facilities (MRFs). This order sets guidelines for the establishment and operation of MRFs to promote recycling and proper waste segregation.
   iii. DAO 2019-21: Guidelines Governing Waste-to-Energy (WTE) Facilities for the Integrated Management of Municipal Solid Wastes. This order provides guidelines for the establishment and operation of WTE facilities using MSW.
   iv. DAO 2001-34: Regulations on the Management of Hazardous Waste. This order sets regulations for the management of hazardous waste to ensure safe disposal and minimize environmental impact.

2. The **Food and Drug Administration (FDA)** has issued Administrative Orders related to the manufacture of food and food-related products.

   a. **AO 2004-0153:** Revised Guidelines on Current Good Manufacturing Practice in Manufacturing, Packing, Repacking, or Holding Food. This order sets the standards for good manufacturing practices to ensure food safety and quality.

   b. **AO 2014-0030-A:** Revised Rules and Regulations Governing the Labeling of Prepackaged Food Products. This order provides guidelines for the labeling of prepackaged food products to ensure accurate and informative labeling.

   c. **AO 2020-0017:** Revised Guidelines on the Unified Licensing Requirements and Procedures of the Food and Drug Administration. This

order simplifies the requirements and processes for licensing food manufacturing facilities

3. The **Department of Interior and Local Government (DILG)** has issued several key issuances related to industrial facilities.
   a. **Joint Circular No. 01 s. 2016:** Revised Standards in Processing Business Permits and Licenses in All Cities and Municipalities. This circular provides guidelines for the processing of business permits and licenses, ensuring a streamlined and standardized approach across all local government units.

   b. **Memorandum Circular No. 2020-084:** Provision of Grace Period and/or Other Related Mechanisms in the Collection of Applicable Taxes, Fees, and Dues from Energy Facilities Relative to the Extended Imposition of the Enhanced Community Quarantine (ECQ). This circular addresses the financial impact of the ECQ on energy facilities and provides mechanisms for easing the collection of taxes and fees.

   c. **Memorandum Circular No. 2019-62:** Policy and Guidelines on Sewage Treatment and Sewage Management System. This circular outline the rules and regulations for sewage treatment and management, promoting proper waste disposal and environmental protection.

Professional Practice

The **Scope of Practice** of Professional Chemical Engineers include the following:

1. **Technical Consulting**. Provides professional, independent advisory, and technical solutions to industrial plants, government organizations, non-government organizations, and multilateral institutions appertaining to problems which require the application of chemical engineering concepts and theories. It shall include the process improvement and optimization, process and operational safety, raw materials treatment and processing, product realization, by-products generation, logistics and supply chain enhancement, water and wastewater treatment and disposal system management, quality and environmental system management, standard operating procedure development, and emerging technologies adoption and implementation.

2. **Investigation.** Any inquiry, examination or study that involves chemical engineering concepts and theories, undertaken for the determination of the causative factors of the happening of any adverse event taking place in any facility, establishment or that which involves any commission or omission of acts which endangers the life, liberty, and property of a person, towards the determination of liability or obligation under any law, rules, and regulations. that took place, inside or outside the vicinity of an Industrial Plant or any facility. It utilizes science, technology, law, and techniques, sustainability engineering and technologies; or chemical engineering knowledge, or both, principles, and professional skills, for the determination, discovery, and verification of facts to arrive at a valid, logical, or sound conclusion for any administrative, civil, criminal or any related cases. This shall also include investigating any persons, materials, substances, products, by-products, raw materials handling and storage, industrial and non-industrial waste handling, storage, disposal, and compliance, structures, components, equipment, industrial and non-industrial processes, and systems that fail to attain design capacities, efficiency, mandatory industrial process compliance, inspection and worthiness, sound environmental and safety requirements.

3. **Process, Plant, and Equipment Design** – Any act to conceptualize and simulate processes, size process equipment and pipelines, strategically design the control systems, consider process and occupational safety requirements and

layers of protection to the design of an industrial plant or related facilities, or both. This function also includes Hazard and Operability Studies, Design Gap Analysis, and Reliability, Availability, and Maintainability Studies. In the conduct of these activities, the latest version of design tools and technologies and other similar application software may be used. The Professional Chemical Engineer shall affix one's signature and seal on every page of the output from these activities.

4. **Supervision of Installation including Monitoring of Construction Activities and Commissioning of Industrial Plants.** Any act or process of administration, management, inspection, direction, control, and overseeing the construction of Industrial Plant related to chemical engineering design requirements in accordance with the approved design and its commissioning to ascertain that the facility functions as intended. It also involves the technical acceptance of equipment supplied at the project site which includes quality control appertaining to the technical specifications and completeness against packing lists. It may also include functions such as progress monitoring constraints and activities, adjusting, when necessary to ensure completion of installation on schedule and within budget or constraints, and accepting or closing the project.

5. **Pilot-Testing.** Refers to the process of conducting small-scale experiments or trials to evaluate and validate the feasibility, performance, and efficiency of a chemical plant, process, or technology before implementing it on a larger scale. It serves as a crucial step in the development, optimization, and commercialization of chemical plants, processes, and equipment.

6. **Manufacturing Operation, including Integrated Management Systems and Systems Thinking.** This shall refer to the operation, supervision, and management of production or manufacturing facility, or both of any establishment where Unit Operations, Unit Processes, Chemical Reaction Engineering and a series or combination thereof are involved, including the management of waste and waste disposal and the operation of the pollution control and abatement facilities relating to any production or manufacturing operations or of any Industrial Plant.

7. **Research and Development.** Any work, activity, and engagement directed towards the discovery, development, introduction, innovation, and improvement of products, services, systems, operations, and processes

involving the application of Chemical Engineering concepts and theories. It also pertains to basic research leading to breakthroughs in Chemical Engineering. It can also refer to multi-disciplinary research which involves a substantial application of Chemical Engineering concepts and theories.

8. **Quality Assurance.** Plan, execute, and oversee inspection and testing of product to confirm quality and conformance to specifications and deliverables. Assist Production or Manufacturing Operation, or both in tracking, documenting, and reporting quality levels. Analyze and investigate product complaints or reported quality issues to ensure resolution in accordance with company guidelines and external regulatory requirements.

9. **Academia.** Teaching, lecturing, reviewing and doing research in an academic environment that involves application and demonstration of chemical engineering principles shall be considered professional chemical engineering practice.

The Professional Chemical Engineer can enter into different **Fields of Specialization** after gaining significant relevant experience or completing advance training or educational qualifications to enhance competencies and skills. Chemical Engineers can enter the following fields:

1. **Forensic Investigation.** Any examination, study, inquiry, investigation, consultation, and review involving the application of science, technology, law, forensic principles, and other related techniques in relations to Chemical Engineering knowledge, principles, and professional skills, for the determination, discovery, and verification of facts to arrive at a valid, logical, or sound conclusion for any administrative, civil, criminal or any related cases;

2. **Quality Management System.** Develop or update, or both the company procedures to ensure capture, investigation, and proper documentation of complaints. Monitor risk-management procedures and maintain problem logs for identifying and reporting issues to management and product development;

3. **Government Regulatory Functions.** The regulation, inspection, and monitoring of compliance of an Industrial Plant to laws, rules and regulations relating to good manufacturing practices, process safety, food safety, pollution control and

abatement, including solid wastes and wastewater management, industrial gas emission, and chemical storage, handling, and transport, shall be considered as an area of Chemical Engineering practice. As such, the Department of Environment and Natural Resources, Department of Justice, Department of Public Works and Highways, Department of Trade and Industry, Department of the Interior and Local Government, Department of National Defense, Department of Science and Technology, Department of Foreign Affairs, Department of Agriculture, Department of Energy, Department of Health, Philippine Space Agency, the Local Government Units and other related government agencies are required to hire Chemical Engineers to dispose of the aforementioned regulatory functions.

4. **Entrepreneurship.** Deals with the commercialization of chemical engineering technologies from its development to incubation, then to mainstream market adoption, sales, and distribution;

5. **Corporate Governance.** The Professional Chemical Engineer may assume Board Membership in Utility Concessionaires as well as in establishments, imbued with public interest, where such establishment engages in operations that employs the concepts and theories of chemical engineering.

6. **Chemical Reaction Engineering and Catalysis (CREC).** It deals with the (bio)chemically reactive systems of engineering significance and focuses on the understanding, design, optimization, and advancement of processes that involve chemical reactions and (bio)chemically reactive systems such as reaction kinetics, thermodynamics, transport phenomena processes, reactor design and operation, catalysis, and their applicability regardless of scale.

7. **Nuclear Processes and Operations.** They refer to activities, within the areas of Chemical Engineering and Chemical Reaction Engineering, performed in the Nuclear Reactive Systems. This shall include nuclear power generation, nuclear fuel cycle, radiation protection, reactor design and operation, fuel processing, nuclear waste treatment and management, nuclear strategies and policy-making, peaceful and military purposes.

8. **Nanotechnology.** Refers to the scientific and technological discipline related to chemical engineering that involves manipulating matter at the nanoscale,

typically at dimensions of one to 100 nanometers. It encompasses the understanding, design, and control of materials and systems at the nanoscale level.

9. **Environmental Engineering and Management.** Application of chemical engineering principles, methodologies, and techniques to solve environmental problems and address sustainability challenges. It involves the design, development, and implementation of processes and technologies that mitigate environmental pollution, promote sustainable practices, and protect human health and the ecosystem. This also includes industrial waste management, pollution control, and other related activities.

10. **Sustainability Engineering.** Focuses on the application of chemical engineering principles and practices to promote sustainable and environmentally friendly processes within the chemical industry and other related sectors. It aims to minimize the environmental impact of chemical processes, reduce resource consumption, and develop sustainable alternatives to conventional chemical processes.

11. **Biomedical Engineering**. Combines principles of chemical engineering with biomedical sciences and technology to develop innovative solutions for healthcare and medical applications. It focuses on the application of chemical engineering principles, processes, and materials to advance the understanding, diagnosis, treatment, and prevention of diseases.

12. **Biochemical Engineering.** Combines principles of biology, chemistry, and engineering to develop processes, technologies, and products related to the production and utilization of biological materials. It focuses on applying engineering principles to understand, manipulate, and optimize biological systems for various applications, including healthcare, pharmaceuticals, agriculture, energy, and environmental sustainability.

13. **Biomolecular Engineering.** Combines principles of biology, chemistry, physics, and engineering to manipulate and engineer biological molecules and systems for various applications. It focuses on understanding the structure, function, and interactions of biomolecules, such as proteins, nucleic acids,

carbohydrates, and lipids, and leveraging that knowledge to design and create new molecules, materials, and technologies.

14. **Tissue Engineering.** Combines principles from biology, engineering, and medicine to create functional, three-dimensional tissues or organs for medical applications. It aims to develop methods and technologies to repair, replace, or regenerate damaged or diseased tissues, ultimately restoring normal tissue function and improving patient outcomes. This also includes designing and optimizing biomaterials, controlling chemical reactions, and creating suitable microenvironments for cell growth and tissue formation.

15. **Materials Science and Engineering.** Focuses on understanding the structure, properties, processing, and performance of materials. It involves the study, development and design of new materials, as well as the improvement and optimization of existing materials, to meet specific technological, industrial, and societal needs.

16. **Corrosion Engineering.** Focuses on understanding and preventing the degradation of materials due to corrosion. This includes the study of the various factors that contribute to corrosion, including environmental conditions, material composition, and electrochemical reactions. It is aimed to develop strategies to mitigate corrosion, extend the lifespan of materials, and ensure the integrity and safety of structures and equipment.

17. **Energy Engineering and Management.** Application of chemical engineering principles and techniques to address energy-related challenges, optimize energy utilization, and promote sustainable energy practices. It encompasses the design, analysis, and optimization of energy systems and processes, as well as the development and implementation of energy management strategies.

18. **Metrology.** Performs scientific study and practice of measurement. It involves the development, implementation, and application of measurement techniques, standards, and instruments to ensure accurate and reliable measurements across various fields of science, industry, and commerce. This shall also include calibration of methods, procedure, substances, person, materials, equipment and measuring devices.

19. Emerging Technologies requiring Chemical Engineering Knowledge, Principles and Applications.

Industries have recognized the competencies of professional chemical engineers which made them qualified for occupying technical and management positions such as:

- Process Supervisors
- Planning and Production Control Managers
- Logistics Managers
- Production Managers
- Pollution Control Officers
- Regulatory Compliance Officers
- Plant Managers
- Quality Assurance Managers
- Middle Management Positions
- Top Management Positions
- Entrepreneurs

Government Agencies have also hired chemical engineers to occupy significant positions such as:

- Division Chief
- Division Managers
- Technical Personnel
- Researchers
- Compliance Inspectors
- Environmental Managers
- Department Secretary
- Department Undersecretary

Academic Institutions have achieved milestones in with chemical engineers who occupied positions such as:

- Professor
- Assistant Professor
- Department Head
- Dean

- Administrative Head
- Researcher
- Scientist

The **Philippine Institute of Chemical Engineers (PIChE)** is the only one Accredited Integrated Professional Organization for Chemical Engineers in the Philippines. All licensed chemical engineers are automatically members upon payment of the required dues.
PIChE has its chapters distributed based on areas which include the National Capital Region (NCR), Luzon, Visayas, Mindanao and International. The chapters handle the membership needs and coordination to constantly update on current issues affecting the profession and to organize members during activities like the annual national convention, the Chemical Engineering Week Celebration, the different CPD seminars and other CSR activities.
Members are able to expand their network of opportunities thru engagement in chapter activities and further develop their competencies by learning from the more experienced members. Students are able to invite chemical engineers in different events to encourage them to pursue the profession.

Affiliations have been established locally and internationally with the following organizations:

1. **Asian Pacific Confederation of Chemical Engineering (APCChE).** APCChE is composed of 13 member societies from countries in the Asia Pacific where the Philippines, thru PIChE, is a founding member in 1975. PIChE is a trustee member of the APCChE and hosted the 2nd APCChE Congress in 1981 and 20th APCChE Congress in 2023. APCChE holds a bi-annual congress for the Asia-Pacific community of chemical engineers, industrial chemists, and related professions to come together to discuss latest developments in the field of practice. PIChE sends representatives to attend the APCChE Congress and to attend the board meetings.

2. **Philippine Technological Council (PTC).** PTC is the umbrella organization of the 13 Professional Engineering Organizations in the Philippines. PIChE, being a trustee, fully supports the endeavors and activities of PTC. **PTC is a member of the ASEAN Federation of Engineering Organizations and represents the Philippines at the International Engineering Alliance as**

Provisional Signatory to the Washington Accord. PTC established the Certification and Accreditation System for Engineering Education which serves as basis for the accreditation of engineering programs in the Philippines.

3. **ASEAN Federation of Engineering Organizations (AFEO).** The AFEO is composed of engineering organizations from the ASEAN Region and maintains the ASEAN Engineer Registry. Each economy is represented by one engineering organization duly recognized to represent all the engineering professionals in the country. The PTC is a member of the AFEO and serves to represent all engineering professionals from the Philippines. All Licensed Chemical Engineers who have at least 7 years of professional industry experience may apply to be recognized as an ASEAN Engineer by the ASEAN Federation of Engineering Organizations. Simply submit the application form together with pertinent supporting documents to your respective chapters which will formally endorse the application to the PIChE NBOD which, in turn, will recommend to PTC your recognition. Contact your Chapter or PIChE for more details.

4. **Philippine Federation of Professional Associations (PFPA)** The PFPA is the umbrella organization for all professional organizations in the Philippines. It has, as its members, the four (4) Councils which are:
   a. Philippine Technological Council (PTC)
   b. Council for Built and Natural Environments (CBNE)
   c. Council of Professional Health Associations (COPHA)
   d. Council of Business Management Professionals. (CBMP)

   As a member of PTC, PIChE is considered as one of the professional organizations under PFPA.

Applicable Safety Requirements

Chemical engineering is a vital force behind industrial progress, contributing significantly to economic growth and development across various industries, such as energy, manufacturing, pharmaceuticals, and food processing. However, the profession inherently involves high-risk operations due to the hazardous chemicals, processes, and energy systems the engineers work with. To manage these risks and ensure the safety of workers, the public, and the environment, chemical engineers must conform and comply with a comprehensive set of safety requirements and standards.

1. Process Safety

Process safety is a critical aspect of chemical engineering, focusing on preventing accidents and incidents that could lead to the release of hazardous materials or energy. According to the widely accepted definition from the American Institute of Chemical Engineers (AIChE) Center for Chemical Process Safety (CCPS), **Process Safety is "a disciplined framework for managing the integrity of operating systems and processes handling hazardous substances by applying good design principles, engineering, and operating practices".**

In 2024, the Department of Trade & Industry (DTI) – Bureau of Philippine Standards (BPS) published and promulgated the **Philippine National Standard (PNS) 2186:2024** entitled "**Process Safety Management System – Guidelines for Implementation**". This standard was prepared by the Institute of Chemical Engineers (PIChE) and reviewed and approved for adoption by DTI-BPS. The PNS 2186:2024 aims to assist organizations in developing and implementing effective process safety management systems using a risk-based approach. The standard outlines the following key objectives:

- Designing a robust process safety management system;
- Correcting deficiencies in existing process safety management systems; and,
- Improving process safety management practices.

Although the provisions in this PNS are voluntary, all organizations—especially the major hazard installations—are strongly encouraged to adopt the standard.

Implementing PNS 2186:2024 can enhance the effectiveness of safety systems, reduce the frequency and severity of major hazard incidents, and improve long-term safety, environmental, and business performance.

2. Hazardous Wastes Management

Republic Act No. 6969, or the "Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990", is a key law in the Philippines that regulates the handling of toxic chemicals, hazardous materials, and nuclear wastes. Chemical engineers play a major role in ensuring companies comply with this law, which helps protect the environment, public health, and workplace safety. Key requirements under RA 6969 include:

- **Registration of Chemicals and Hazardous Substances** – All companies involved in handling hazardous chemicals must register with the Department of Environment and Natural Resources (DENR).
- **Chemical Safety and Waste Management** - Companies must create and follow plans for safely collecting, storing, treating, and disposing of hazardous wastes to prevent pollution of air, water, or soil.
- **Compliance to Priority Chemical List (PCL) and Chemical Control Orders (CCO)**: The DENR issues Priority Chemical List (PCL), which includes chemicals that are considered highly hazardous, and Chemical Control Orders (CCOs) for specific substances, limiting their use, manufacture, or transport, including importation and exportation.
- **Chemical Accident Preparedness and Response** - Organizations are required to develop emergency plans to handle chemical spills or accidents, including safety drills, protective equipment, and coordination with local authorities. `

3. DOLE Occupational Safety and Health Standards and Republic Act 11058 “New OSH Law”

The Department of Labor and Employment (DOLE) **Occupational Safety and Health (OSH) Standards**, first established in 1978 as part of the Labor Code of the Philippines, are regulations designed to ensure the safety, health, and welfare of workers across all industries. Compliance to the standards is vital in preventing workplace injuries and safeguarding workers’ health & safety.

In 2018, **Republic Act No. 11058**, titled **“An Act Strengthening Compliance with Occupational Safety and Health Standards and Providing Penalties for**

Violations Thereof," was enacted, with its implementing rules issued under DOLE Department Order 198-18. Commonly referred to as the "New OSH Law," this legislation adopts a risk-based approach to prevent workplace accidents, establishes protocols for handling imminent danger situations, mandates OSH training for personnel and workers in high-risk occupations, promotes workers participation in safety programs, and imposes penalties for non-compliance with OSH standards. The law enhances accountability and reinforces the importance of safety in all workplaces, especially in industries with high safety risks.

4. Other Applicable Regulations & Practices in the Design, Engineering, and Operation of Industrial Installations

a. **National Building Code of the Philippines** - known as Presidential Decree No. 1096, was enacted in 1977 to regulate the design, construction, occupancy, and maintenance of buildings and other structures throughout the country. This legislation serves as a comprehensive framework to ensure the safety, health, and general welfare of the public by setting minimum standards for building construction and occupancy. It covers a wide range of aspects, including structural integrity, fire safety, accessibility, and energy efficiency.

b. **Philippine Electrical Code (PEC)** - The PEC provides guidelines for the safe installation, operation, and maintenance of electrical systems in buildings and structures. It covers topics such as wiring methods, grounding, protective devices, and provisions for electrical installations in hazardous locations.

c. **The Fire Code of the Philippines** - Formally known as Republic Act No. 9514, was enacted in 2008 to enhance fire safety standards throughout the country. This legislation establishes comprehensive guidelines for the prevention, detection, and suppression of fire hazards in various structures, including residential, commercial, and industrial facilities.

d. **Philippine Mechanical Engineering Code** - The code sets forth guidelines for the design, installation, operation, and maintenance of mechanical systems in buildings and structures. It covers topics such as heating, ventilation, air conditioning (HVAC), plumbing, and fire protection systems.

e. **Recognized And Generally Accepted Good Engineering Practices (RAGAGEP)** - RAGAGEP refers to industry standards, codes, and best practices that guide the safe design, operation, and maintenance of chemical systems. Some of the commonly used RAGAGEPs in the industries are:

- *American Society of Mechanical Engineers (ASME) Codes*
- *National Fire Protection Association (NFPA) Standards*
- *American Petroleum Institute (API) Standards*
- *International Organization for Standardization (ISO) Standards*

Challenges and Opportunities

A **sustainable future requires a fundamental shift toward a circular economy**, where products' entire life cycle, including end-of-life considerations, is fully accounted for. Central to this shift are principles of green chemistry and sustainable engineering, which emphasize minimizing waste and maximizing resource efficiency. The chemical engineering profession, which initially emerged to tackle the growing challenges of the petroleum-refining industry over a century ago, is once again being called upon to address the pressing environmental and industrial challenges of today. While petroleum has been the dominant feedstock for chemical production due to its abundance and versatility, it is a highly heterogeneous organic resource. Moving forward, the **focus is shifting toward more efficient, environmentally friendly, and cost-effective manufacturing processes**. A wider range of feedstocks, including oxygenated resources like lignocellulosic biomass, offer exciting possibilities as alternatives to fossil fuels. For chemical engineers, this presents opportunities to advance reductive chemistry and develop innovative processes that accommodate these diverse feedstocks.

However, the flexibility in feedstock use also requires advancements in fundamental research. For example, there is a need for improved thermodynamic data to enhance the modeling of molecules that include oxygen and other heteroatoms. This would enable more accurate predictions and process designs. In addition to new feedstocks, chemical engineers can lead the development of distributed manufacturing systems and process intensification, which aim to create smaller, more localized production units that could compete with traditional large-scale fossil-based operations. Success in these areas will depend on strong collaboration between academic researchers and industry to bring these innovations to scale and demonstrate their feasibility in real-world applications.

As the world transitions from a linear economy to a more sustainable, circular model, specific opportunities for chemical engineers are emerging. One such opportunity lies in the **redesign of processes and products to reduce or eliminate pollution.** Another area of innovation is finding ways to reduce waste and repurpose it into useful resources, while also designing products with longer

lifespans. Additionally, the **use of sustainable feedstocks rather than fossil resources opens up new pathways for reducing the environmental impact of manufacturing**. These trends have profound implications not only for the global chemical industry but also for emerging economies, such as the Philippines.

In the Philippines, the **growing focus on automation, robotics, artificial intelligence (AI)** is creating both challenges and opportunities for chemical engineers. As these technologies are integrated into industrial processes, engineers face the challenge of ensuring that safety protocols keep pace with the rapid advancements. Many new technologies outstrip existing safety regulations, making it difficult to ensure that cutting-edge innovations align with established safety frameworks. Moreover, the increasing importance of cybersecurity adds another layer of complexity. As facilities become more digitized, they are exposed to potential threats such as cyber-terrorism and sabotage, which could lead to catastrophic releases of hazardous materials if not properly managed.

With **The revival of the nuclear energy sector in the Philippines**, one particularly challenging area for chemical engineers is addressing the public perception of nuclear energy. Historical accidents have left a legacy of fear and distrust, making it difficult to build public confidence in the safety of nuclear power, despite modern advances in safety technologies. Nonetheless, these trends also bring numerous opportunities for improving process safety management. The integration of automation and AI enables real-time monitoring of processes, allowing engineers to predict and prevent potential hazards before they escalate into accidents. Predictive analytics powered by AI can significantly enhance the efficiency and safety of plant operations.

Although the safe use of nuclear energy sector remains controversial, the recent interest on its use in the Philippines offers chemical engineers a chance to apply lessons learned from past incidents to implement robust safety measures. These modern measures aim to not only prevent accidents but also rebuild public trust in nuclear energy as a safe and environmentally friendly alternative to traditional fossil-fuel-based power plants. Moreover, insights gained from nuclear safety practices can be applied to other chemical processes, enhancing safety across industries. The development of inherently safer technologies within chemical processes, such as those that use non-toxic or less hazardous materials, can

contribute to sustainable production methods that reduce accidents and minimize environmental impacts.

By capitalizing on these opportunities, chemical engineers can drive significant advancements in process safety management while supporting the sustainable growth of industries. In doing so, they will play a vital role in ensuring the protection of workers, the public, and the environment in an era of rapid technological change and environmental urgency.

Code of Ethics

Preamble

We, the Chemical Engineers of the Philippines, are bound by a common commitment to undertake our duties based on the shared values of ethical conduct, professional competence, innovative practice, technical proficiency, social and civic responsibility, good governance, global competitiveness and sustainable development.

1. Fundamental Guiding Principles
   - 1.1 We shall be guided in all our relations by the highest standards of honor and integrity; and shall act objectivity with fairness, impartiality, and equity and in a spirit of cooperation and harmony to all.
   - 1.2 We shall consider the environment, the safety, health and welfare of the pubic as paramount importance in the performance of our professional duties.
   - 1.3 We shall commit to perform professional services only in areas of our competence and shall not permit ourselves to be described as an expert or a consultant, unless we possess the necessary qualifications and experience, and professional independence, to act as an independent and unbiased adviser.
   - 1.4 We shall uphold at all times the dignity of the chemical engineering profession and shall protect it from misrepresentation and dishonor.
   - 1.5 We shall avoid being associated with any enterprise and individuals of questionable refutation/character or involved in any endeavor contrary to law or public welfare or from allowing the use of our good name by the same.
   - 1.6 We shall not knowingly engage in work which by its nature is against the law or against ethical standards.
   - 1.7 We shall endeavor at all times to give credit to those to whom credit is properly due.
   - 1.8 We shall practice confidentiality whenever our work requires it and will respect the rights of privacy of others.
   - 1.9 We shall acknowledge our own mistakes and error when proven wrong and refrain from distorting or manipulating the facts to justify our mistake.
   - 1.10 We shall cooperate and work harmoniously with other engineers and professionals.

1.11 For those of us who are involved in teaching, we shall treat our students with fairness and respect, and shall follow the practices, rules and regulations pertaining to teacher-student relations as contained in our respective school's manual of policies.

2. Relation with Peers
   2.1 We shall exchange general information and experience, encourage the ethical dissemination of knowledge in chemical engineering with our fellow chemical engineers, contribute to the work our accredited integrated professional organization (APO) and chemical engineering schools, and cooperate in such other endeavors as will enhance the effectiveness of the chemical engineering profession.
   2.2 We shall conduct a review/audit of the work of another chemical engineer for the same client or employer only after the said client or employer shall have informed him/her of such an endeavor.
   2.3 We shall accept to review journal articles, scientific publications and similar matters requested by a journal editor or publisher, only with the written request of said party and in accordance with the condition of the review being requested.
   2.4 We shall not engage in the significant use of the ideas or written work of another chemical engineer without giving due credit to the person concerned.
   2.5 We shall not attempt to attract another chemical engineer from another employer by false or misleading pretenses.

3. Relation with other professionals
   3.1 We shall promote our own interest with dignity and integrity as professionals.
   3.2 We shall respect the mandates of other professions
   3.3 We shall avoid making degrading statements or comments regarding other professions and/or professionals.

4. Relation with Employer or Client
   4.1 We shall act in professional maters for our employer/client as faithful agents or trustees, and avoid conflicts of interest; and shall consider it our professional obligation to protect the interest of our employer/client.
   4.2 We shall make known to our employer/client before undertaking an engagement all our other professional obligations, financial interest, or other considerations which might restrict or interfere with our meeting the legitimate expectations of our client or employer.
   4.3 We shall not accept outside employment to the detriment of our regular work. Before accepting any outside employment, we shall seek approval

from our employer/client.

4.4 We shall not accept compensation, financial, otherwise from another employer/client who is in the same line of business or has conflicting interest with our employer/client, without the consent of all parties; we shall not accept compensation directly or indirectly from parties dealing with our employer/client except with the consent of the same.

4.5 When holding any government position or office of public trust, we shall not take undue advantage thereof nor shall we engage in activities that would be unfair to any of the parties concerned.

4.6 We shall make every effort to bring to the immediate attention of our employer/client any dangerous defect in equipment or structures or dangerous conditions of operations, which come to our knowledge for remedial action.

4.7 We shall advise our employer/client of the risk before undertaking any work if, in our opinion, the work requested of a chemical engineer by our client or employer poses certain doubts as to our being able to obtain successful results and subject to provisions of section 2.2.

4.8 We shall present clearly the consequences or risks that will arise if our professional judgment or work, for which we are responsible, is overruled.

4.9 We shall formally advise our employer/client if we perceive that a consequence of our duties will adversely affect the present or future health or safety of our colleagues, co-workers or the public.

4.10 We shall not hesitate to advise our employer/client to engage the services of other experts or specialists on problems on which our information or experience is inadequate

4.11 We shall be conservative in all our estimates and shall endeavor to be fair and accurate in our reports, testimonies, statements and others.

4.12 We shall, as far as practicable, charge fees at such rates as are reasonable enough to warrant adequate, satisfactory and quality service.

4.13 We shall not use unfair or improper means in obtaining professional work.

4.14 We shall not use equipment, supplies, and laboratory or office facilities of our employer/client to carry on outside private practice without the employer's/client's consent nor without offering reimbursement for the employer's/client's costs.

4.15 Upon undertaking work for an employer/client, we shall enter into an agreement regarding ownership of any and all data, plans, improvements, patents, designs or other records which we may develop

or discover while in the employ of such employer/client. In the absence of a written agreement, the following shall apply:

a. When we use information obtainable only from our employer/client, which is not common knowledge or public property, any result in the form of design, plans, inventions, processes, etc., shall be regarded as the property of the employer/client.
b. When we use our knowledge or information or data which by prior publication or otherwise is public property, then the results in the form of designs, plans, inventions, processes, etc., become our property or property of the chemical engineer; and the employer/client is entitled to their use only in the case for which we have been retained.
c. All work and results accomplished by us outside the field for which we were employed or retained shall remain our property
d. Special data or information obtained by a chemical engineer from his/her employer/client or which he/she creates as a result thereof is to be held and considered confidential, and while it is ethical to use such data or information in his/her practice as forming part of his/her professional experience, its publication without prior permission of his/her employer/client is highly improper.
e. Any other agreements entered into by the chemical engineer with his/her employer/client not covered by the above provisions, the Intellectual Property Code shall apply.

5. Relation with the Public

5.1 We shall always make ourselves ready and available and be willing to render professional service, even without compensation, in cases of accidents and other exigencies.

5.2 When serving as expert or technical witness before any court of law or commission we shall express an engineering opinion only when it is based on an adequate knowledge of the facts of the issue, our technical competence in the subject matter, and the belief in the accuracy and propriety of our testimony.

5.3 We shall express a professional opinion only when we are adequately informed of the facts related thereto and the purposes for which the opinion is asked.

5.4 The chemical engineer who is an employee, official or advisor of a governmental or quasi-governmental unit shall not participate in the formulation of decisions involving services solicited or provided by him/her or his/her organization in private or public engineering practice, where conflict of interest exists.

5.5 We shall not solicit or accept a contract from a governmental body in which a principal or officer of our organization is directly involved with or employed.

5.6 We shall not issue statements, criticism or arguments on matters of public concern which are inspired or paid for by private interest, unless he/she indicates in whose behalf he/she is making the statement.

5.7 We shall not indulge in self-laudatory advertisement nor make exaggerated, untrue, or misleading statements in media or any public forum.

5.8 We shall at all times strive to serve the public interest

a. We shall endeavor to participate in civic, career guidance for youths, and work for the advancement of the environment, and the protection of the safety, health, and the well- being of our community.
b. We shall not sign, approve, or put his/her dry seal on plans and/or specifications that are not in conformity with applicable engineering standards. If the client/employer insists on such unprofessional conduct; they shall withdraw from further service on the project.
c. We shall endeavor to extend public knowledge and appreciation of chemical engineering and its achievements.
d. We shall adhere to the principles of sustainable development in order to protect the environment for future generations.

6. Continuing Education

6.1 We shall strive to continue our professional development throughout our career by participating in continuing education provided by our integrated and accredited professional organization and other entities accredited by PRC CPD Council, and reading technical literature; and shall provide opportunities for the professional development of those under our supervision.

6.2 We shall endeavor to acquire knowledge of the latest developments in the area of chemical engineering relevant to the services that we render to our clients or employer.

7. Violations

Violations of any provision of this Code shall constitute an unethical or unprofessional conduct, and shall be dealt under the provisions of RA 9297 and other laws that penalize unprofessional conduct and actions.

8. Effectivity

This Code shall take effect after fifteen (15) days following its publication in the Official Gazette.