Board of Sanitary Engineering
Board Resolution No. 03
Series of 1998
Adoption of New Syllabi for the Subjects in the Sanitary Engineering Licensure Examination

WHEREAS, Section 13, Art. III of R.A. No. 1364, otherwise known as the Sanitary Engineering Law, enumerates the subjects in the Sanitary Engineering Licensure Examination;

WHEREAS, the Board of Sanitary Engineering, on September 27, 1983, issued Board Resolution No. 5, Series of 1983, amending the contents and weights of the subjects given in the Sanitary Engineering Licensure Examination;

WHEREAS, after consultation with the Commission on Higher Education (CHED) and the various Schools, Colleges and Universities offering the Sanitary Engineering Course, the Board deems it necessary to formulate its syllabi for the examination subjects;

WHEREFORE, the Board RESOLVED, at it hereby RESOLVES, to adopt the syllabi of the subjects in the Sanitary Engineering Licensure Examination contained in the document appended hereto marked as A NNEX ÒAÓ and made an integral part of this Resolution which shall become part of the Rules and Regulations of the Board of Sanitary Engineering.

This Resolution shall take effect after fifteen (15) days following the completion of its publication in the Official Gazette or a newspaper of general circulation, whichever is earlier.

All resolutions and rules and regulations issued by the Board inconsistent with this Resolution are hereby repealed or modified accordingly.

Let copies of this resolution be furnished to all schools, colleges and universities offering the Sanitary Engineering Course for their guidance and reference.

Done in the City of Manila this 11th day of November 1998.

ANTONIO E. KAIMO
Chairman

ALBERTO J. AZARCON, JR.
Member

Attested:
CARLOS G. ALMELOR
Secretary, Professional Regulatory Boards

Approved:
HERMOGENES P. POBRE
Commission Chairman

ALFONSO G. ABAD
Associate Commissioner

AVELINA DELA REA-TAN
Associate Commissioner

Annex A
THE SANITARY ENGINEERING LICENSURE EXAMINATION SYLLABI

Section 4 of the Sanitary Engineering Law (Republic Act No. 1364) vests the Board of Sanitary Engineering the authority to discharge other powers and duties as may affect the ethical and technological standards of the Sanitary Engineering Profession in the Philippines. Section 13 of the same act enumerates the subjects in which the applicants for certificates of registration shall be examined. Moreover Section 6 Article I of PRC Resolution No. 338, Series of 1994 provides that each subject shall have an approved syllabus which must be harmonized with the curriculum in the undergraduate level. The primary objective of the Sanitary Engineering Licensure Examination is to obtain valid and reliable information as to whether examinees possess the technical competence required for admission to the profession. Technical competence in this respect includes not only technical knowledge but also the ability to apply such knowledge skillfully and good judgement and an understanding of professional responsibility.

I. COVERAGE

The general coverage of the examination is divided into five (5) major subjects with their corresponding weights as follows:

1. Water Supply Engineering 25%
2. Wastewater Engineering 25%
3. Environmental Engineering 20%
4. Plumbing and Public Health Engineering 15%
5. Civil Engineering.....15%

Each major subject is subdivided into specific top or concerns, as well as their corresponding description. These syllabi are intended to serve as frame of reference for the examiners, the academe, applicants for the examination and the Continuing Professional Education Program.

II. EXAMINATION STANDARD AND NATURE

The following shall be taken into consideration in the preparation of questions:

a. A relatively uniform standard of technical competence should be established and consistently followed to ensure the reliability of examination results. As such, questions given in the examination shall be covered under the topic enumerated in the syllabi. The examination in each subject shall be comprehensive and well-balanced in style.
b. Questions shall emphasize technical knowledge that is currently relevant to the Sanitary Engineering practice and adequately disseminated in textbooks and other professional literature. Trivial, outdated, inapplicable, unsettled and controversial questions should be avoided.
c. There shall be a suitable mixture of easy, moderate and difficult questions as categorized according to degree of difficulty.
d. Questions shall be framed in a clear and concise manner taking into consideration the degree or level of knowledge or proficiency for each topic. Instructions or requirements should be clearly stated.

e. Questions should include adequate tests of higher cognitive abilities such as comprehension, interpretation, application, analysis, problem-solving and other higher-order thinking skills.
f. The assigned weight for each test question and the estimated time for each major subject shall be indicated.
g. Electronic and scientific calculators are allowed. However, programmable calculators and pocket personal computers are not allowed and will be confiscated if brought to the examination room.

III. SUBJECTS OF EXAMINATION

1. Water Supply Engineering Topics Covered:

A. *Hydrology*: Elementary statistics; hydrologic or water cycle; evaporation and transpiration; streamflow hydrographs; probability in hydrology; flood frequency; erosion sedimentation and river basins; reservoirs, flood protection and water conservation; applications of hydrology.

B. *Microbiology*: Study of microorganism; biological characteristics of bacteria; fungi; rickettsia; algae; viruses; protozoa and other organisms and their effects on water supply; pathogenicity; isolation and identification methods; growth and kinds of media; multiple fermentation tube technique for colliform organisms; differential tests for colliform organisms; applied microbiology in water; application of bacteriology to public health and the sanitary control of the environment; biotechnology.

C. *Advanced Water Treatment*: Basic application of principles of hydraulics, hydrology, chemistry and engineering design in providing safe and adequate water standards; choice between sources of supply; impurities found in water for human consumption; principles of drinking water treatment; swimming pool water treatment principle; treatment process for losed circuit swimming pool water; treatment of industrial process water.

D. *Sanitary Chemistry*: Water and sewage analysis; standard solution; turbidity and color; acidity alkalinity; chemical coagulation of water; hardness; ph; residual chlorine and chlorine demand; water softening; nitrogen; flouride; chlorides; iron; manganese; solids; dissolved oxygen; biochemical oxygen demand; sulfates; volatile acids; phosphorous and phosphates; phenolic substance, radioactive such as detergent; oil and grease; and persistent pesticide; other chemicals; gas analysis; laboratory control of water purification processes.

E. *Water Sources and Treatment*: Use and importance of water; determination of the sources, quantity and quality of water supply; water demand; intake/collection structures; different methods of water treatment and purification; chemical coagulation and flocculation; sedimentation; filtration and other methods; disinfection; protection of water supply from environmental pollution or contamination.

F. *Water Distribution System*: Analysis and hydraulics design of transmission and distribution network and appurtenances; reservoirs and storage facilities; pumping stations and facilities; fire protection system; construction and maintenance of distribution system.

G. *Waterworks Management and Economics*: Industrial organization and management concept, theories, functions and practices; human behavior; introduction to decision making tools; PERT/CPM; case studies; concepts, theories, principles, methodology and tools for engineering economic analysis; financial accounting cash flows; cost accounting; financial mathematics; true value of money; capita recovery cost; investment decision criteria (internal rate of return, benefit-cost ratio, etc.); engineering oriented application.

2. Wastewater Engineering
Topics Covered:

A. *Industrial Wastewater Collection, Treatment and Disposal*: Wastewater treatment objectives, methods and design; unit operations; designs of facilities; theory and practice in the treatment of industrial waste on streams and sewerage systems; physico-chemical treatment systems; aerobic and anaerobic biological treatment system; problem and method of disposal; sludge treatment and disposal; stream pollution studies.

B. *Domestic Wastewater Collection, Treatment and Disposal*: Determination of sewage flowrate; hydraulics of sewers; design of sewers; sewer appurtenances and special structures; pump and pumping stations; sewerage and characteristics; study of theory and methods of sewerage treatment; analysis of objectives and principles underlying unit operations employed in sewage treatment; sewage disposal as it affects the degree of treatment required; design of facilities for physical chemical and/or biological treatment of sewage and for disposal of sludge and sewage effluent; anaerobic treatment system; activated sludge; rotating biological contractors; trickling filter; plain, facultative and aerated lagoons.

C. *Storm Drainage*: Design floods; flood control structures; storm water distribution and design of canal network, flume, pipe system, pump stations and other drainage facilities and appurtenances.

3. Environmental Engineering
Topics Covered:

A. *Ecology*: Principles and concepts pertaining to ecosystem and to energy in the ecological system; biochemical cycles; species and individuals in the ecosystem; freshwater ecology; marine ecology; estuarine ecology; terrestrial ecology.

B. *Solid Waste Managemen*t: Study of the relation of solid waste to health; principles, methods and administration of solid waste collection; treatment and disposal; conditions affecting quantities of solid waste and their analysis; re-cycling and re-use.

C. *Environmental Impact and Assessment*: Concept and use of Environmental Impact Assessment; prediction and assessment of impact in air, water and land environment; prediction and assessment of impact in the biological environment; prediction and assessment of impact in the socio-economic environment; methods of impact and analysis.

D. *Atmospheric Pollution and Abatement*: Study of the sources and effects of air pollution; sampling analysis and instrumentation of air pollutants; prevention and control; air pollution and standards; testing and control of toxic gases; smoke stacks.

E. *Noise Pollution and Abatement*: Study of the sources and effects of noise pollution; prevention and control; noise pollution standards.

F. *Land and Soil Pollution and Abatement*: Sources and effects of land pollution, prevention and containment and control; treatment; soil characteristics; bacterial pathways; groundwater contamination and pollution.

G. *Lake and River Pollution Abatement*: Source of water pollution; stream sanitation; receiving waste characteristics; waste quality standards; treatment of sewage; testing and treatment of industrial effluent.

H. *Pertinent Laws and Regulations*: (a) Rules and Regulations of the Environmental Management Bureau (EMB), Department of Environmental and Natural Resources (DENR); (b) Rules and Regulations of Laguna Lake and Development Authority (LLDA); (c) Rules and Regulations of Metro Manila Development Authority (MMDA) and Municipal and City Ordinances; (d) Rules and Regulations of the Housing and Land Use Regulatory Boards (HLURB); (e) Rules and Regulations of the Metropolitan Waterworks and Sewerage System (MWSS); (f) Rules and Regulations of the Department of Health (DOH); (g) Philippine Environmental Code.

4. Plumbing and Public Health Engineering

Topics Covered:

A. *Plumbing*

1. Development of Sources of Water for Residences: Determine the amount and quality of water; develop sources and provide sanitary measure against contamination and pollution.
2. Sewage Treatment and Disposal for Building and Premises Design and construction of septic tank, privy, cesspool, seepage or sanitary pit; location and planning, influent and effluent piping, installation standards; materials used.
3. Water Supplying System for Building and Premises Planning and design of water supply distribution, branch and all pipings for fixture, appurtenances and appliances within the building and premises; cross connection; installation standards; materials used; distribution pumps and lifts.
4. Sanitary Piping and Ventilating System Planning and design of piping system from plumbing fixtures, house drains, house sewers, horizontal branches, soil stacks, stacks or waste vents, drains, traps, clean-outs, special waste manhole and appurtenances within the building and premises; installation standards; materials used.
5. Storm and Subsurface and Drainage System Planning and design of ground subsurface storm drains; downspouts, floor and roof drains, area drains, catch basin manholes and appurtenances within the building and premises; installation standards; materials used.
6. Water Heating System Planning and design of domestic hot water system supply, distribution system and return pipes, water heater and appurtenances for domestic use within the building and premises.
7. Fire Protection System in Building Planning and design of dry and wet standpipes, fire hose valves, fire hose cabinets, and hoses and fire extinguishers (including dry chemicals), sprinkler system, smoke and heat detectors for fire detection and protection within the building and premises.
8. Gas Oil and Compressed Air Piping Piping for gas, oil and compressed air lines, tank and similar appurtenances within the building and premises.

9. Water Pump, Tank, Cistern, Sewage and Sump Pit Sizing the capacity of elevated and hydropneumatic tanks, cistern, sewage and sump pits and appurtenances within the building and premises.
10. Pipe Installation and Workmanship Methods and techniques of pipe laying and installation; joints and installation; joints and connection; pipe hangers and supports; storage and protection from damages; inspection and acceptance of workmanship.
11. Plumbing Plan and Specification [Preparation of] orthographic working drawings, isometric, schematic diagrams, riser diagrams, details, symbols and legend and specification writing.

B. *Public Health Engineering*

1. Control of Communicable Disease Basic knowledge in the identification of diseases and theories of epidemics; classification of contagious, infectious and communicable diseases, their sources and their carrier; water and food borne diseases recognizable characteristics; disease vectors; mode of transmission and detection of diseases, their development, its prevention and control; control of environment.
2. Biostatistics or Vital Statistics The topics cover the basic knowledge in the science and analysis of vital data on population with particular reference to birth, marriage, morbidity and mortality; compilation and statistic analysis of information pertinent to the life and death of people in a community.
3. Insect and Vermin Control Public health importance of insects and rodents; basic knowledge of insect vectors and lower animals harborages and breeding areas and as agent that borne diseases and method of transmission; growth and control of different insects, vermin, rodent and possible micro-organism; pesticides and different methods toexterminate vermin and other animal parasites (insect infestation and rodent control).
4. Light and Ventilation in Building Basic knowledge in the scale of light sources and illumination; lighting design; lighting surveys and procedures; evaluation of results; control of lighting; humidity; temperature; requirement of good ventilation; exhaust system; methods of ventilation; ventilation standards; patio requirements; opening of windows; height of rooms; width of halls and corridors; eaves, overhang requirement and need for airconditioning the building.
5. Food Sanitation Objectives of food sanitation; public health significance; basic knowledge in the different food-borne diseases and its control; essentials of food establishment and sanitation; sanitary and hygienic quality of food and its preservation; essentials of sanitary milk production; quality of milk and its preservation; milk borne disease classification and its mode of transmission; animal disease and mode of transmission to men; kind of disease resulting from taking infected milk; pasteuralization of milk; location, planning and functional design; food preservation; meat products; poultry and eggs; fish and shellfish; food inspection, handling and storage; food handling equipment and cleaning.
6. School Sanitation Importance of school sanitation; basic information on suitable suites for schools and sanitary facilities; service in a school sanitation program; design and planning environmental sanitation requirement and hygiene for schools; minimum standards for the sanitation and safety of the school plan; requirement of food ventilation; operation and maintenance of sanitary facilities for school suites.
7. Industrial Hygiene Principles involved in inspection and evaluation of the work environment or industrial/occupational environment; basic knowledge of the various causes of accident in industry; activities affecting the health and safety of workers; conditions of his environment conducive to comfort and physical

efficiency; safety measures to prevent accidents; industrial dust and other emissions and its control; radiation; heat stress; chemical and biological hazards, biomechanics; occupational diseases and basic ergonomics; protective devices.

8. Swimming Pool and Bathing Places Public health significance; classification of bathing places; basic knowledge and design in construction, operations and sanitary maintenance of swimming pool and bathing places; sanitary requirement or features and specification of appurtenances; quality of swimming pool water and public bathing places; disinfection and control of water-borne diseases; safety precautions at pools and bathing places; personal regulations for bathers; treatment process pumping/filtration.
9. Municipal and Rural Health Sanitation Basic knowledge in the concepts and theories in the location, planning, design, construction, operation, maintenance and treatment of municipal and rural water supply systems; sewage and waste disposal; specification and features of pit privies and septic tank treatment; drainage and solid waste; insect and rodent control; emergency housing.
10. Pertinent Laws and Allied Codes The topic deals with the basic knowledge of pertinent laws and allied codes such as Sanitary Engineering Law, Master Plumber Law, Sanitation Code, National Plumbing Code, National Building Code (P.D. No. 1096), PRC Law (P.D. No. 223), National Fire Code, National Water Code, Local Government Code, Code of Ethics and appropriate Local and Municipal Ordinances.

5. Civil Engineering

A. *Mathematics*

1. Algebra and Trigonometry: set theory; real number system; functions, relations, operations and their graphs; algebraic expressions; linear equations; quadratic equations; system of equations; theory of equations; elementary matrix theory; permutations, combinations and probability; roots and powers; arithmetic and geometric progressions; factoring; complex numbers; trigonometric functions; identities and equations; logarithms; solution of right and oblique plane and spherical triangles; application of the geometric functions; application of the terrestrial mensuration.
2. Analytic and Trigonometry: plane coordinate systems; equations and their loci; straight lines, conic sections and their higher plane curves; parametric equations; mensuration of the area, perimeter and centroid of plane figures; volume, surface area and center of gravity of solids; lines and plane dihedral and polyhedral angles; prism, pyramid, cylinder, cone and sphere; transformation of coordinates; coordinate in space; space loci; quadric surfaces; proofs and application of Cavalieri's Theorem; Pappus Theorem and the Prismodal Theorem.
3. Differential Calculus: functions, limits and continuity; derivatives; application of derivatives; related time rates; higher derivatives; curve tracing; differentials and its applications; curvative of plane curve; indeterminate forms and differentiation of vector-valued functions.
4. Integral Calculus: concepts of anti-derivatives; integration methods; definite integrals; applications; vectors in the threedimensional space; partial derivatives; multiple integrals; series expansion of functions.
5. Differential Equations: ordinary and partial differential equations; simultaneous linear differential equations; systems of linear and non-linear equations; applications; special functions; mathematics of programming.
6. Advanced Engineering Mathematics: determinants and matrices; vector analysis; equation of higher order and degree; power series expansion;

infinite series; Fourier series; Laplace transform; complex variables; boundary value problems.

B. *Physical Sciences*

1. Chemistry: matter and energy; theory of atoms and molecules; chemical periodicity; principles of calculation of chemical changes; chemical bonding; hydrogen, oxygen and water; solutions; chemical equilibrium; thermochemistry; chemical kinetics; nuclear chemistry; correlation of properties of elements of electronics configuration and periodicity; structures and properties and important classes of organic compounds; fundamentals of environmental chemistry and pollution control.
2. Physics: mechanics, wave; sound; acoustics; heat; thermometry and thermal expansion; electricity, magnetism; electromotive force; mirrors and lenses; atomic physics; nuclear physics; theory of relativity; quantrum theory.
3. Geology: study of earth materials such as rocks and rock masses Ð their characteristics and how these characteristics are acquired, modified and transformed through geologic processes; introduction to stratigraphy; surface and underground waters; river control prevention of landslide; and foundation problems involving structures built on natural materials.

C. *Surveying*

1. Basic concepts: Use of surveys; operations in surveying; measurement and adjustments; field and office works; theory and use of surveying instruments; care of instruments.
2. Basic surveying and measurements: Horizontal distance measurements; vertical distance measurements; angles and direction measurement, stadia, plane table, and alidade sextant.
3. Survey operations: Traverse survey; Area Calculation; Triangulation; Trilateration; Astronomical Observation.
4. Engineering Surveys: Typographic survey; hydrographic surveys; barometric and precise leveling; locating shoreline and soundings; principles and uses of aerial survey.

D. Hydraulics

1. Fluid Mechanics: Properties of fluids; pressure intensity; fluid statics and kinematics; flow through orifices, nozzles, venturi meters, weirs and other flow meters; fluid flow in pipes and open channels; fluid measurements.
2. Hydraulics: Flow in pipes, dams, spillways and open channels; energy method; introduction to varied flow phenomena; forces on submerged bodies; pumps, turbines and hydropower systems; introduction to irrigation engineering; scour and and environmental impacts; hydraulics analysis and design of dams; spillways, gates and outlet works, canals, canal structures, pressure conduits, stilling basins and energy dissipators.

E. *Design and Construction Management*

1. Engineering Mechanics: Statics and dynamics; operation with the free body concepts; equilibrium of coplanar and noncoplanar force systems; analysis of trusses; friction; kinetics and kinetics of particles and rigid bodies; centroids and moments of inertia; motion of particles and rigid bodies; force, mass and acceleration.

2. Strength and Materials: Axial force; shears and bending moment; strain and relationship; stresses for shear, torsion and bending; combined stresses; beam deflections; buckling; indeterminate beams; elastic instability.
3. Engineering Materials: Properties and use of engineering materials (metals, woods, concrete, asphalt, plastics, bricks, etc.) including mechanical, acoustical, electrical, magnetic, chemical, optical and thermal properties; testing equipment-tension, compression, bending, shear, torsion and impact test.
4. Theory of Structures: Axial Forces, shear, moment, deflection and reactions, equation of static equilibrium, condition, stability and determinacy; theory of stress analysis of determinate structures; frame analysis, influence lines; computation of stresses; indeterminate structures; slopedeflections; analysis of structures subjected to dynamic loads; stiffness and flexibility methods of analysis.
5. Soil Mechanics Foundations: Soil behavior and properties; soil identification and classification; soil volume density relationships; effective stress concept; flow of water in soils; consolidation and settlement analysis; lateral earth pressure; slope and wall stability analysis; subsurface exploration; principles of foundation behavior and earth structure design and construction; retaining walls; cofferdams; groundwater control and dewatering; soil improvement and stabilization.
6. Design of Timber Structures: Properties of wood; design of tension members; design of compression members; design of members due to bending moments and shear; connectors (joint and splices).
7. Reinforced Concrete Principles: Properties of concrete materials; working stress and ultimate stress; design due to bending, shear and diagonal tension; bond and anchorage; deflections; columns; slabs; beams; footings; retaining walls; prestressed concrete.
8. Design of Steel Structure: Properties of structural steel; design of tension members; design of compression members; design of beams and columns; connections; water towers.
9. Contracts Specifications: Law of contracts; quasi-contracts; government contracts; preparation of contracts; judicial decisions; principles of the law of tort and damages; sanitary engineering practice; specification writing; engineering relations and ethics.
10. Construction Project Management: Construction project organization; planning and scheduling; networking; resource leveling and scheduling; estimating; construction methods and operations; equipment operation and maintenance; cost planning and control; quality control; project monitoring and evaluation; contract administration.

IV. CONDUCT OF EXAMINATION

The examination shall be totally or fully computerized. The number of questions and drawing of extraction of questions shall be in accordance with Section 9 of PRC Resolution No. 338, Series of 1994. The number of questions for each subject shall not be less than twenty (20) to four (4) points each nor more than one hundred (100) at one (1) point.

The examination shall be closed books and notes. Examinees shall be given computation or scratch paper which must be submitted with the answer sheets.

V. CHANGE IN THE SYLLABI

The syllabi may be amended as the need arises to conform with new techniques/trends and/or advances in technology applicable to the sanitary engineering profession in consultation with the Commission on Higher Education (CHED) and the academe.