

1. INTRODUCTION

The Complementary Studies Examinations are part of the Examination Syllabus issued by the Canadian Engineering Qualifications Board (CEQB) of Engineers Canada. It comprises four, three-hour examination papers and an Engineering Report. Candidates will be assigned examinations and the Report based on an assessment of their academic background.

Information on examination scheduling, textbooks, materials provided or required, and whether the examinations are open or closed book, will be supplied by the constituent association.

Best practices in engineering education show that engineering students should receive training not only in the technical aspects of engineering, but also in broader issues such as the impact of engineering on society, and the roles and responsibilities of professional engineers. In addition, taking courses in the humanities, to broaden their perspective and expose them to methods of thinking outside of engineering. Collectively, this training is called “Complementary Studies”.

2. PURPOSE OF THE COMPLEMENTARY STUDIES SYLLABUS

The purpose of Complementary Studies, and of this syllabus, is to assure that professional engineers have an awareness of the broader context of engineering. This allows them to understand and even foresee the impact of engineering solutions in a social and global context. Whereas engineers have always had an obligation to make decisions that are consistent with the safety, health, and welfare of the public, and to disclose factors that might endanger the public or the environment, societal shifts mean that engineers now need to extend this same conscientiousness: to the global environment, to the responsible use of energy, to responding to public health and social needs, and to public policy.

A first step, therefore, is to understand the economics that drive so many engineering decisions, to recognize the paramount role and responsibility of engineering to the safety and health of the public; to understand and apply ethical theory in engineering practice; and to recognize the role that engineering has in creating a sustainable society in times of challenging global changes such as diminishing resources, ecological degradation, and climate change. The following examinations address these topics.

3. COMPLEMENTARY STUDIES EXAMINATIONS

11-CS-1 **Engineering Economics**

Basic concepts of engineering economics through understanding of the theoretical and conceptual financial project analysis. Types and applications of engineering economic decisions. Capital, cash flow, and the time value of money concepts. Nominal and effective interest rates when considering loans, mortgages, and bonds. The application of present worth analysis, annual equivalent analysis and rate of return analysis in evaluating independent projects, comparing mutually exclusive projects, analyzing lease vs. buy alternatives and making decisions. After-tax financial analysis requiring an understanding of capital cost allowance (depreciation) and corporate income tax. Understanding methods of financing and capital budgeting. Break-even, sensitivity and risk analyses.

11-CS-2 Engineering in Society – Health and Safety

The duties and legal responsibilities for which engineers are accountable; safety laws and regulations; and a basic knowledge of potential hazards and their control: biological hazards – bacteria, viruses; chemical hazards - gases, liquids and dusts; fire and explosion hazards; physical hazards – noise, radiation, temperature extremes; safety hazards – equipment operation; workplace conditions - equity standards, human behaviour, capabilities, and limitations; managing safety and health through risk management, safety analyses, and safety plans and programs; practices and procedures to improve safety. The roles and social responsibilities of an engineer from a professional ethics point of view, as applied in the context of Canadian values. The integration of ethics into engineering practice, and its effect on public safety and trust.

11-CS-3 Sustainability, Engineering and the Environment

Basic knowledge of soil, water and air quality engineering: soil and water interaction, water supply issues, human activities and their interaction on soil, air and water resources. Fundamentals of: soil erosion, water quality, atmospheric pollution (carbon and nitrogen cycle), climate change, risk assessment. Basic knowledge of renewable energy sources: solar, photovoltaic, wireless electricity, thermal, wind, geothermal, and biofuels. **Introduction to** renewable materials engineering; nano materials, new material cycles. Eco-product development, and product life cycle assessment; recycling technologies; reuse of products; design for disassembly, recycling, e-waste, and reverse manufacturing. Consumption patterns; transportation; environmental communication; consumer awareness. Optimized energy and resources management. Sustainable methods: sustainability indicators; life cycle assessment; regulatory aspects of environmental management, ecological planning.

11-CS-4 Engineering Management

Introduction to management principles and their impact upon social and economic aspects of engineering practice. Engineering management knowledge topics including: market research, assessment and forecasting; strategic planning; risk and change management; product, service and process development; engineering projects and process management; financial resource management; marketing, sales and communications management; leadership and organizational management; professional responsibility. New paradigms and innovative business models, including: sustainable production, products, service systems and consumption; best practices and practical examples of successful implementations of sustainable scientific and engineering solutions.

4. ENGINEERING REPORT

Upon passing the examination(s) assigned by the constituent association, a candidate may be required to write an Engineering Report. The report must demonstrate the candidate's ability to present an engineering problem, observation, or idea, and to analyze it logically and accurately using engineering principles, and to draw conclusions or make recommendations. The work must include acceptable technical content involving engineering analysis, design, development, or research. The report must also demonstrate a satisfactory level of writing and graphical skills, thus the quality of the presentation will be a factor in determining the acceptability of the report.

The report itself need not prove originality of ideas, but the candidate should demonstrate his/her ability to appreciate, present, differentiate between and draw conclusions from observations and ideas. The

definition of a “report” is flexible and could also include discussion and judgement of opposed theories or methods, or a description of a novel technique or process and a discussion of the practicality of its application. The key consideration is that the report address a new issue, and not repeat the coverage of the particular subject available in textbooks. It is the current state of the art, the novel or the contentious that is expected to be explored in the report.

While no rigid rules of format are specified, it is recommended that the report be suitably subdivided and include:

- a) A title page and date
- b) A signed declaration of authorship
- c) A table of contents
- d) A summary of the report and its conclusions
- e) Technical content including analysis, design, development or research
- f) Conclusions and/or recommendations
- g) A list of the technical literature cited
- h) A list of acknowledgements, contributors, reviewers and sources of information

The report should be about 5,000 words long, not including tables and graphs. Diagrams, illustrations, etc. should be clearly and properly identified. It is preferable to locate graphs, diagrams, etc. necessary for the understanding of the text at the place where reference to them is made.