



Confirmatory Exam Program Requirements Transportation Engineering

Transportation Engineering Technical Exams. You must choose three of your four exams from the Transportation Engineering Technical Exam list. Two of these exams must be from Group A and one from Group B listed below.

Transportation Engineering Technical Exams			
Group A		Group B	
07-Tra-A1	Introduction to Transportation Engineering	07-Tra-B1	Transit System
07-Tra-A2	Highway Design	07-Tra-B2	Intelligent Transportations Systems
07-Tra-A3	Traffic Engineering	07-Tra-B3	Logistics and Goods Movement
07-Tra-A4	Pavement Materials, Design and Management	07-Tra-B4	Air Transportation
07-Tra-A5	Transportation Planning and Demand Analysis	07-Tra-B5	Railway Transportation
07-Tra-A6	Geotechnical Materials and Analysis	07-Tra-B6	Highway Construction
		07-Tra-B7	Transportation Economics
		07-Tra-B8	Operations Research
		07-Tra-B9	Traffic Safety
		07-Tra-B10	Geomatics

Complementary Studies. You must also choose one exam from the Complementary Studies below.

Complementary Studies	
11-CS-1	Engineering Economics
11-CS-2	Engineering in Society – Health & Safety
11-CS-3	Sustainability, Engineering and the Environment
11-CS-4	Engineering Management



PEO'S TECHNICAL EXAMINATION PROGRAMS

WHY A TECHNICAL EXAM PROGRAM?

The academic requirement for licensing as a professional engineer in Ontario is a bachelor's degree in engineering from an accredited program at a Canadian university or its equivalent.

The Canadian Engineering Accreditation Board (CEAB) accredits undergraduate engineering degree programs on behalf of the provincial/territorial engineering associations/order, including PEO.

Applicants who do not hold a bachelor's degree in engineering from a CEAB-accredited program may be required to pursue either PEO's *Confirmatory* or *Specific* exam program to demonstrate that they possess the equivalent academic background for licensing purposes.

PEO's TECHNICAL EXAM PROGRAMS *Confirmatory Exam Program (CEP)*. Applicants whose undergraduate Bachelor's engineering degree was obtained via a program that appears to be similar to the respective CEAB-accredited program are usually assigned a Confirmatory Exam Program, which consists of four exams. The intent is to give the applicant an opportunity to demonstrate that s/he has an academic preparation that is deemed to be equivalent to that of a graduate of a CEAB-accredited program.

***Specific Exam Program (SEP)*.** If PEO's assessment reveals that an applicant's academic qualifications are below the established Canadian standard, s/he will be assigned a Specific Exam Program aimed to remedy identified deficiencies for licensing purposes. A Specific Exam Program may consist of Basic Studies exams, discipline-specific exams, Complementary Studies exams and a thesis.

Basic Studies exams are a prerequisite and must be addressed first; PEO will re-evaluate the applicant's file following the successful completion of all Basic Studies exams and may modify the original exam program, and advise the applicant of the options available to address any outstanding exams.

TIME LIMITS FOR WRITING EXAMS

PEO's technical exams are offered twice annually (in May and December).

Applicants must write at least one exam within two academic years following the date of receipt of their exam program notification. Once the exam program is commenced, the applicant must write at least one exam each academic year or the file will be closed. All exam programs must be successfully completed within eight academic years of the date that the applicant was notified of his/her exam program. ("Academic Year" means the period starting September 1 in a year and ending August 31 in the following year.)

HAVING THE FILE CLOSED

An application file will be closed if any one of the following conditions applies:

- not completing all exam requirements within the specified time limit;
- not writing at least one exam in each academic year after writing the first exam;
- failing the same exam on three attempts;
- failing a total of five exams;
- failing two Basic Studies exams; or
- failing to write a failed exam within one academic year for CEP.

PERFORMANCE STANDARDS

The pass mark for all PEO exams is 50%.

Confirmatory Exam Program. An applicant will be considered to have successfully completed the CEP if the average of the technical exam marks is at least 55% and a pass mark (at least 50%) was received on the Complementary Studies exam.

If an applicant fails two exams or fails the same exam twice in a CEP, s/he may be assigned a Failed-to-Confirm exam program, which may consist of additional exams in the Basic Studies, discipline-specific and Complementary Studies categories.

GOOD-PERFORMANCE REVIEW POLICY

Confirmatory Exam Program. To meet the "good-performance" review criterion, an applicant must have written two technical exams at the first sitting and achieved a minimum average of 65% with no mark below 60%.

After a second exam sitting, if an applicant has passed three technical exams with no mark below 60%, s/he may receive consideration for exemption from writing the Complementary Studies exam. If an applicant attempted two exams in the first sitting but failed one, s/he may still qualify for a "good-performance" review if s/he passes the failed exam with a mark of 70% or higher and achieves 60% or higher on the previously unwritten technical exam attempted at the second sitting.

Important: If an applicant has been assigned a **Directed Confirmatory Exam Program**, the good performance criteria are different; to be eligible, in addition to meeting the above criteria, all the directed exams must be addressed as well. Applicants are advised to contact the Exam Centre to discuss further.

Note:

- Good-Performance reviews are not applicable to Specific Exam Program and Failed-to-Confirm exam program applicants.

WHEN AND WHERE PEO EXAMS ARE OFFERED

PEO technical exams are held in May and December at 14 centres in Ontario. Exams are usually offered over a five-day period.

Registration packages to write are mailed in January for the May sitting and in July for the December sitting.

If the technical exam package is not received by the times indicated above, applicants should call the Exam Centre.

PROCUREMENT OF TEXTS AND OTHER MATERIALS FOR AN EXAM

To help in the procurement of all the suggested technical text books Contact customer service of Login Brothers at orders@lb.ca, through the website www.lb.ca or 1-800-665-1148 to assist you. It is recommended to always purchase the latest edition of any suggested textbook.

If an applicant does not have the current text listing or the text(s) is out of print, the applicant is advised to contact the Exam Centre (see below).

Recent written exams (i.e., reprints) are available on-line at PEO's website at www.peo.on.ca for free download. These past exams are available to provide the applicant with knowledge of the exam format, etc. The answers/solutions of past exams are not available at PEO.



PEO'S TECHNICAL EXAMINATION PROGRAMS

EXAM FEES

All Exam Fees are non-refundable.

First Exam Fee	\$700
Each Subsequent Exam Fee	\$200
Submission of an Engineering Thesis	\$360

COURSES-IN-LIEU

For all course(s)-in-lieu of PEO exam(s), applicants must get prior approval from PEO. A request must be in writing and should include a description of the proposed university calendar course and should be submitted at least two months in advance of the course's registration deadline.

Applicants must arrange for the official grade report(s) to be forwarded to the Licensing and Registration Department upon the completion of the course(s).

NOTE: *Courses-in-lieu are not acceptable for:*

- **Basic Exams,**
- **Confirmatory Exams,**
- **Directed Confirmatory Exams,**
- **Failed exams**

EXAM CENTRES

Exams are offered annually in May and December at the following centres in Ontario:

Belleville	London	Sudbury
Chalk River	Ottawa	Thunder Bay
Hamilton	Peterborough	Toronto
Kingston	Sarnia	Windsor
Kirkland Lake	St. Catharines	

The timetable information and exact location of exams are posted on PEO's website early in April to applicants writing exams in May, and early in November for those writing in December.

Applicants living inside Ontario must write at an Ontario centre. One of the centres listed may be selected. Applicants living outside Ontario may make special arrangements to write outside Ontario or Canada. Call the Exam Centre for further instructions if special arrangements are required.

ADDITIONAL INFORMATION

Order of exams. Basic Studies exams are a prerequisite and must be written first. Following the successful completion of all Basic Studies exams, applicants may write the remaining exams in any order. However, it is recommended that exams in less-advanced subjects be written first. Passing an exam in an advanced subject does not merit credit for a less-advanced subject.

English Language Skills. An acceptable level of English—both written and spoken—is required to practise engineering and to successfully complete PEO exams. If an applicant needs to improve English language skills, s/he should contact one of the many English as a Second Language Programs run by schools and community organizations throughout Ontario.

Penalties. Using notes or other aids in an exam where these are not allowed is strictly forbidden. Applicants caught doing so will have their paper confiscated and risk having their licence application withdrawn.

Exam Results. Exam results are normally mailed within 45 working days following writing of the exam. No results will be given over the telephone or in person at PEO office. Exam papers will not be returned to applicants and answers are not available. Failed exams are automatically re-read. However, applicants may request a formal re-read

of an exam paper. A non-refundable fee of \$330 is charged in the event a formal re-read is requested by an applicant. Requests for a re-read must be received within 30 days after an applicant has been notified of the exam mark.

Reapplying After A File Has Been Closed. If a file has been closed, an applicant may reapply with the understanding that the regulations and policies in effect at the time of the new application will be enforced.

An application for licence fee and all other associated fees will be required.

If a file was closed for poor academic performance, the applicant may be required to show that s/he has taken course(s) in the subject(s) covered by any failed exam(s).

All recorded failed exams from a previous application must be successfully addressed before an applicant will be allowed to pursue the new program.

WORKING IN ENGINEERING BEFORE LICENSURE

Applicants may work in engineering provided a licensed professional engineer takes responsibility for the work. It is illegal to use the title "professional engineer" or any variation thereof (project engineer, systems engineer, etc.) as an occupational or business title that might lead to the belief that a person is a licensed professional engineer.

NEED MORE INFORMATION?

For more information about licensing/registration requirements, please contact:

Licensing and Registration Department
Professional Engineers Ontario
40 Sheppard Avenue West, Suite 101
Toronto, ON M2N 6K9
Tel: (416) 224-1100 / 1-800-339-3716
Fax: (416) 224-8168 / 1-800-268-0496
<http://www.peo.on.ca>

PEO'S CONFIRMATORY EXAMINATION PROGRAM

Confirmatory Exam Program (CEP)

PEO's **Confirmatory Exam Program** (CEP) consists of three technical exams in the applicant's engineering discipline and a *Complementary Studies* exam.

- This program must be completed within eight academic years following the date of receipt of the exam program notification. ("Academic Year" means the period starting September 1 in a year and ending August 31 in the following year.)
- Applicants will have successfully completed the *Confirmatory Exam Program* if the average of their three technical exams is at least 55% with no mark below 50% and they achieve a pass (50%) on the *Complementary Studies* exam.
- To qualify for the good performance review, applicants must address all the directed exams, if the applicant is assigned a *Directed Confirmatory Exam Program*

Good-Performance review for CEP applicants may be warranted as follows:

- Applicants who pass any two technical exams at their first sitting, with a minimum average of 65% and with no mark below 60%, may be exempted from completing the remaining exams in the *Confirmatory Exam Program*.
- Applicants who complete three technical exams in two sittings with no mark below 60% may be exempted from the *Complementary Studies* exam.
- Applicants who fail one technical exam and achieve a mark of 70% or higher on the failed exam on their second attempt, and 60% or higher on a previously unwritten technical exam attempted at the same sitting, may be exempted from completing the remaining exams in their *Confirmatory Exam Program*.

A **Failed-to-Confirm** Exam Program for CEP applicants, consisting of additional exam(s), will be assigned to applicants who do not confirm their engineering knowledge via their *Confirmatory Exam Program*. At least one of the following will apply:

- Applicants who do not achieve an average mark of at least 55% on the three technical exams will be assigned a *Failed-to-Confirm* Exam Program and one additional technical exam will be assigned.
- Applicants, who failed the same exam twice or failed two different exams will be assigned a *Failed-to-Confirm* Exam Program where an additional exam will be assigned for each exam failure. They must also pass the failed exams.

Please note: For applicants who are assigned a **Failed-to-Confirm** Exam Program, their engineering experience does not begin until after the academic requirements for licencing are met, and they will be required to demonstrate 48 months of engineering experience from that time.

A **file will be closed** under the following circumstances:

- If there is loss of contact (no active mailing address), the applicant's file will be closed.
- Applicants who do not attempt any exams within two academic years after notification of their exam program will have their file closed.
- Once an exam program commences, applicants must write at least one exam each academic year or their file will be closed even if the applicant has successfully passed exams in the past.
- Applicants who fail a technical/Complementary Studies exam on their first sitting must pass the failed exam within one academic year or their file will be closed.

If you have any questions concerning the above listed, please contact the Exam Centre
416-840-1097, 1057, 1096, 1095 or 1(800) 339-3716 1097, 1057, 1096, 1095
e-mail: exams@peo.on.ca

Last Revision: May 2019

TRANSPORTATION ENGINEERING EXAMINATIONS

INTRODUCTION

Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of Transportation Engineering examinations consists of seventeen, three-hour examination papers and an engineering report. Candidates will be assigned examinations based on an assessment of their academic background. Examinations from discipline syllabi other than those specific to the candidate's discipline may be assigned at the discretion of PEO's Academic Requirement Committee.

Information on examination scheduling, textbooks, materials provided or required, and whether the examinations are open or closed book, will be provided by PEO's Examinations Centre.

BASIC STUDIES

04-BS-1 Mathematics

Calculus, vector and linear algebra; applications involving matrix algebra, determinants, and eigenvalues; first and second order linear ordinary differential equations; Laplace transforms; vector algebra; vector functions and operations; orthogonal curvilinear coordinates; applications of partial derivatives; Lagrange multipliers; multiple integrals; line and surface integrals; integral theorems (Gauss, Green, Stokes); power series.

04-BS-2 Probability and Statistics

Concepts of probability; events and populations; probability theorems; concept of a random variable; continuous and discrete random variables; probability distributions; distributions of functions of a random variable; sampling and statistical estimation theory; hypothesis testing; simple regression analysis.

04-BS-3 Statics and Dynamics

Force vectors in two- and three-dimensions; equilibrium of a particle in two- and three-dimensions; moments and couples; equilibrium of rigid bodies in two- and three-dimensions; centroids; centres of gravity; second moment of area; moment of inertia; truss, frame and cable static analysis; friction; planar kinematics of particles and rigid bodies; planar kinetics of particles and rigid bodies; work and energy, impulse, and momentum of particles and rigid bodies.

04-BS-5 Advanced Mathematics

Series solutions of differential equations; series solutions of ordinary differential equations; boundary value problems and orthogonal functions; Fourier series; numerical methods; use of computers for numerical solution of engineering problems, including techniques involving library subroutines and spreadsheets; approximations and errors; interpolation; systems of linear and non-linear algebraic equations; curve fitting; numerical integration and differentiation; and ordinary differential equations.

04-BS-6 Mechanics of Materials

Definitions of normal stress, shearing stress, normal strain and shearing strain; shear force and bending moment diagrams; members subjected to axial loading; members subjected to torsional loading; compound stresses; Mohr's circle; deformation of flexural and torsional members; failure theories; elastic and inelastic strength criteria; columns.

04-BS-11 Properties of Materials

Properties of materials for mechanical, thermal and electrical applications; atomic bonding; solid solutions; crystallization; equilibrium phase diagrams; applications to steel and aluminium alloys; heat treatments; structure and special properties of polymers and ceramic materials; general characteristics of metallic composites, polymeric composites and concrete; introduction to materials in hostile environments; corrosion; creep at high temperature; refractory materials; subnormal temperature brittle fracture.

04-BS-14 Geology

The structure of the earth, plate tectonics, earthquakes and igneous activity; minerals and rocks including their formation, identification, basic properties, and classification; processes of weathering, erosion, transport, and deposition of geological materials and their results of significance to engineering; occurrence, flow, and quality of groundwater; introductory aspects of structural geology including faulting, folding, and the overall formation of discontinuities and their effect on the engineering properties of rock masses; aerial photography and geological maps.

04-BS-15 Engineering Graphics and Design Process

Engineering drawing; orthographic sketching; standard orthographic projection; principal views, selection and positioning of views; visualization; conventions and practices; first and second auxiliary views; basic descriptive geometry; section views, types, hatching conventions; basic dimensioning requirements; tolerance for fits and geometry control; detail drawings and assembly drawings; other drawings and documents used in an engineering organization; bill of materials; fasteners and welds; design process and methods; project management and teamwork; requirements and function analysis in design; conceptual design and testing; concept evaluation design factors such as: cost, quality, manufacturability, safety, etc.; systems modelling and design detail.

GROUP A

07-TRA-A1 Introduction to Transportation Engineering

Fundamentals of transportation systems and the application of engineering, mathematical and economic concepts and principles to transportation issues, including transportation planning; public transit; traffic engineering; geometric design; pavement design; and the economic, social and environmental impacts of transportation.

07-TRA-A2 Highway Design

Basics of highway engineering geometric design, including vehicle traction and resistance; principles of braking; stopping sight distance and passing sight distance; highway horizontal and vertical alignment; intersection layout design; channelization; grade separation and interchange design; and cut and fill calculations.

07-TRA-A3 Traffic Engineering

Fundamental techniques of traffic systems analysis with emphasis on congested traffic networks. Topics include: transportation demand; supply and equilibrium; traffic assignment; network equilibrium; system optimality; traffic flow theory; shockwaves; highway capacity analysis; introduction to deterministic and stochastic queuing analyses; intersection signal control types and related timing methods; traffic simulation; and introduction to the basic elements of Intelligent Transportation Systems (ITS).

07-TRA-A4 Pavement Materials, Design and Management

Basics of flexible and rigid pavement analysis, design and management and pavement materials; pavement types; axle loading; pavement stress and deflection; theoretical and empirical pavement design methods; pavement design life; performance and failure criteria; ride quality; pavement distress types; pavement maintenance; pavement subgrade; subbase; base and surface layer materials; asphalt types and characteristics; asphalt mix tests; mix design; pavement construction; and an introduction to modern pavement management.

07-TRA-A5 Transportation Planning and Demand Analysis

Elements of design and execution of an urban transportation planning study; introduction to travel demand modelling; analysis of environmental impacts; modelling transportation-land use interactions and transportation project evaluation; contemporary transportation planning issues and policies; role of planning within the wider context of transportation decision-making and the planning and design of urban areas; applications to person-based travel in urban regions; freight and intercity passenger transportation; transportation-related environmental, social, and economic sustainability issues.

07-TRA-A6 Geotechnical Materials and Analysis

Materials: origin of soils; soil identification and classification; compaction; permeability; pore water pressure and effective stress; compressibility and consolidation; shear strength; stress paths; and critical states; frost action; associated laboratory tests. Analysis: elastic stress distribution; settlements; times of settlements; introductory analysis of lateral earth pressures, bearing capacity, and slopes; seepage; well flow and confined 2-D flow problems.

GROUP B

07-TRA-B1 Transit Systems

Role of transit in urban areas; classification of transit modes; transit performance and operational analysis; capacity analysis; scheduling; line and network design; systems planning and mode selection; transit economics.

07-TRA-B2 Intelligent Transportations Systems

Modern techniques to optimize the performance of a transportation system with emphasis on traffic networks in congested urban areas; Intelligent Transportation Systems; analysis of advanced traffic management and information systems; history of ITS; ITS user services and subsystems; ITS interoperability and system architecture; enabling technologies for ITS; introduction to telecommunication technologies for ITS; introduction to control theory for transportation systems; traffic flow modelling; static and dynamic transportation network analysis; incident detection; freeway control; and surface street network control.

07-TRA-B3 Logistics and Goods Movement

Introduction to the structure of the freight industry and its relationship to business logistics and planning of supply chains; planning of freight services at the strategic, tactical, and operational levels and modelling of international, inter-city, and urban freight movements; shipper behaviour related to mode choice, carrier selection, adoption of 3-PL and information technology; introduction to the role of advanced technologies (ITS) for freight operations, and the implications of e-commerce on planning of freight services; overview of policy issues, data sources and needs; and the particularities of the freight-transportation context.

07-TRA-B4 Air Transportation

Nature of civil aviation; structure of the airline industry; aircraft characteristics and performance; aircraft noise; navigation and air traffic control; airport planning and design; runway length and orientation; airline operations; aviation system planning.

07-TRA-B5 Railway Transportation

Design, construction and operation of railway lines, railway stations and station structures; signal operations; railway structures (bridges, tunnels, etc.); tramway and other railroads; underground railways; harbour linkages.

07-TRA-B6 Highway Construction

Clearing and excavation; earthworks; compaction and stabilization; highway drainage; rock drilling and blasting; asphalt and cement concrete pavement construction; inspection and quality control.

07-TRA-B7 Transportation Economics

Introduction to the major theories, methods and policy issues in the field of urban transportation economics, including examination of fundamental issues of planning and financing transportation “infrastructure” (roads, ports, airports); demand analysis and forecasting; congestion pricing of highways and transport infrastructure; cost structure and economies of scale; pricing and regulation; network economics; use of analytical techniques for the analysis of real-world urban transportation issues and policy-making.

07-TRA-B8 Operations Research

Models for the design and operation of systems; linear programming; the simplex algorithm; sensitivity analysis and duality; the assignment problem; network design; probabilistic inventory models; Markov chains; nonlinear, integer, and dynamic programming; and probabilistic dynamic programming.

07-TRA-B9 Traffic Safety

Theory and evidence in accident analysis and prevention; crash data analysis; traffic enforcement; road safety advertising; fleet safety; road safety audits; vehicle safety and program evaluation.

07-TRA-B10 Geomatics

Satellite-based positioning systems (GPS); observations and development of mathematical models used for absolute and differential static and kinematic positioning; error analysis; quantitative remote sensing methods using optical, infrared and microwave radiation; physical principles, including governing equations; imaging system geometries; space and airborne sensor systems; radiometric corrections, including calibration and atmospheric correction; geometric corrections; geographic Information Systems (GIS); characteristics of GIS data structures and database management systems; applications to map projections; geodetic datums; coordinate systems; georeferencing; spatial modelling and analysis.

COMPLEMENTARY STUDIES

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.

3.2 ENGINEERING REPORT

Upon passing the examination(s) assigned by PEO's Academic Requirements Committee, 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,

Transportation Engineering Suggested Text Listing

07-Tra-A1, Introduction to Transportation Engineering

Fundamentals of Transportation Engineering: A Multimodal Systems Approach/Jon D. Fricker, Robert K. Whitford

Publisher: Pearson Prentice Hall, Upper Saddle River, NJ 07458, 2004.

ISBN 0-13-035124-5

07-TRA-A2 Highway Design:

(1) "Geometric Design Guide for Canadian Roads" by Transportation Association of Canada (1999, with 2007 Update) This does not have an ISBN. Product Code PTM-GEODES99. This Guide is offered at a special reduced price for students. Please contact Transportation Association of Canada office at 613-736-1350, Ext. 221.

(2) Any Engineering Surveying Textbook which includes Earthwork calculations - Cuts, Fills and Mass Diagrams

(3) The following free downloads from the Internet on earthwork calculations:

http://www.u.arizona.edu/~mhickman/CE466/earthwork_notes.pdf

http://en.wikibooks.org/wiki/Fundamentals_of_Transportation/Earthwork

<http://www.globalsecurity.org/military/library/policy/army/fm/5-430-00-1/CH3.htm>

07-Tra-A3, Traffic Engineering

The candidates must be very thorough with the Canadian Capacity Guide for Signalized Intersections as this is the only publication which is strictly applicable to Canadian traffic conditions.

(1) Principles of Highway Engineering and Traffic Analysis

by Fred L. Mannering and Scott S. Washburn

- Publisher: Wiley; 5 edition (March 27, 2012)

- ISBN-10: 1118120140

- ISBN-13: 978-1118120149

(2) Traffic Engineering (4th Edition)

by Roger P. Roess, Elena S. Prassas, and William R. McShane

- Publisher: Prentice Hall; 4 edition (July 4, 2010)

- ISBN-10: 0136135730

- ISBN-13: 978-0136135739

(3) Traffic and Highway Engineering - Fifth Edition

Nicholas J. Garber and Lester A. Hoel

- Publisher: Cengage Learning; 5 edition (January 1, 2014)
- ISBN-10: 113360515X
- ISBN-13: 978-1133605157

(4) Canadian Capacity Guide for Signalized Intersections - 2008 edition

This guide can be freely downloaded from the following web site. This is the only book written for Canadian traffic conditions and it is very important that the students are thorough with the entire book.

<http://www.cite7.org/resources/documents/CanadianCapacityGuide2008.pdf>

The following web sites contain a wealth of information on the various topics listed in the syllabus:

<http://www.cite7.org/resources/documents/CanadianCapacityGuide2008.pdf>

http://www.telecom.otago.ac.nz/tele302/ref/Stallings_QT.pdf

http://www.cengage.com/resource_uploads/downloads/0324237049_48187.pdf

<http://users.crhc.illinois.edu/nicol/ece541/slides/queueing.pdf>

http://www4.ncsu.edu/~hp/SSME_QueueingTheory.pdf

http://home.iitk.ac.in/~skb/qbook/Slide_Set_1.PDF

http://www.itscanada.ca/about/standards_resources/index.html

<http://www.tc.gc.ca/eng/innovation/its-menu.htm>

<http://www.tc.gc.ca/eng/innovation/its-ontario-quebec-1593.html>

07-TRA-A4 Pavement Materials, Design and Management:

(1) Asphalt Institute Manual Series MS-1: Thickness Design - Highways and Streets (ninth edition)
ISBN: 978-1-934-15401-4

(2) Asphalt Institute Manual: Mix Design Methods for Asphalt Concrete and other Hot Mix Types
(Sixth edition) ISBN: 978-1-934-15402-1

(3) Concrete Pavement Design, Construction and Performance by Norbert Delatte, Taylor & Francis,
2008 ISBN: 978-0-415-40970-4

(4) Pavement Design and Materials by A. T. Papagiannakis and E. A. Masad, John Wiley, 2008
ISBN: 978-0-471-21461-8

(5) Highway Engineering by Paul H. Wright and Karen K. Dixon, Seventh Edition, John Wile, 2004
ISBN: 978-0-471-26461-3

(6) The following free downloads from the Internet on introduction to pavement management:

<http://www.fhwa.dot.gov/infrastructure/asstmgmt/pmprimer.pdf>

<http://ntl.bts.gov/DOCS/pave.html>

<http://www.westvalley.edu/att/Pavement%20Management/index.htm>

<http://www.burlington.org/engineering/Pavement%20Management/PavementManagement.pdf>

07-Tra-A5 Transportation Planning and Demand Analysis

Juan de Dios Ortuzar, Luis G. Willumsen, *Modelling Transport*, 4th Edition, Publisher: Wiley, 2011, ISBN: 978-0-470-76039-0

07-Tra-B1 Transit Systems

VUCHIC, V.R. (2005). Urban Transit: Operations, Planning, and Economics. John Wiley & Sons, Inc. 2005. ISBN 0-471-63265-1

VUCHIC, V.R. (2007). Urban Transit: Systems and Technology. John Wiley & Sons, Inc. 2007. ISBN 0—471-75823X

07-TRA-B2 Intelligent Transportation Systems

(1) Authors: Institute of Transportation Engineers, U.S. Federal Highway Administration

Title: **Intelligent transportation primer**

Publisher: Institute of Transportation Engineers, Washington, D.C.

Year: 2000

ISBN: 0935403450

[Note: The entire book]

(2) Author: Sussman, Joseph M.

Title: **Perspectives on intelligent transportation systems (ITS)**

Publisher: Springer Science + Business Media, New York

Year: 2005

ISBN: 0387232575

[Note: The entire book]

07-TRA-B7 Transportation Economics

(1) Authors: **Millan, Pablo Coto and Inglada (Editors)**

Title: **Essays on Transport Economics**

Publisher: Physica-Verlag (A Springer Company)

Year: 2007

ISBN: 13 978-3-7908-1764-5 Physica-Verlag Heidelberg New York

[Note: Chapters 1, 4, 13, 17]

(2) Authors: **Sinha, Kumeras C. and Labi, Samuel**

Title: **Transportation Decision Making , Principles of Project Evaluation and Programming**

Publisher: John Wiley & Sons, Inc.

Year: 2007

ISBN: 0471747327

[Note: Chapters 1 to 11, 15, 16, 18, 20, relevant material in Appendixes]

(3) Authors: Meyer, Michael D. and Miller, Eric J.
Title: Urban Transportation Planning: A Decision Oriented Approach
 Publisher: McGraw-Hill.
 Year: 2001
 ISBN: 0-07-242332-3

[Note: Chapters 5, 7, 8, 9]

(4) Authors: Khisty, Jotin C. and Lall, Kent B.
Title: Transportation Engineering: An Introduction, Third Edition
 Publisher: Prentice Hall
 Year: 2003
 ISBN: 0-13-033560-6

[Note: Chapters 2, 15 and Appendix A]

07-Tra-B9 "Traffic Safety"

Listed below are several web sites, from which the material can be freely downloaded to assist you to prepare to write this exam that you can download.

http://www.tars.unsw.edu.au/downloads/Fleet_safety_final_for_web_with_cover.pdf

http://www.everestre.com/Portals/0/Documents/Everest_Model_Fleet_Safety_Program.pdf

<http://www.drivingforbetterbusiness.com/pool/benchmarking-workshop-report-jan-08-final.pdf>

<http://www.monash.edu.au/miri/research/reports/muarc166.html>

<http://www.oshatrain.org/courses/studyguides/719studyguide.pdf>

<https://www.fleetsafety.govt.nz/>

<http://eprints.qut.edu.au/7952/1/7952.pdf?referer=www.clickfind.com.au>

https://www.worksafe.vic.gov.au/_data/assets/pdf_file/0015/9510/safe_driving_web.pdf

<http://www.fleetsafetyinternational.com/sites/default/files/documents/Road%20Safety%20Challenge.pdf>

<http://www.jaspersnetwork.org/jaspersnetwork/download/attachments/5439709/Road+Safety+Audits+-+JASPERS.pdf?version=1&modificationDate=1387450051000>

http://www.lags.corep.it/doc/ICorsoSpec/Supporti%20tecnici/au_roadsafetysaudit-2ndedition.pdf

http://ec.europa.eu/transport/road_safety/topics/infrastructure/national-guidelines/pdf/malta-national-guidelines.pdf

<http://www.ite.org/technical/IntersectionSafety/RSA.pdf>

http://www.rms.nsw.gov.au/roadsafety/downloads/guidelines_for_road_safety_audit_practices_full.pdf

http://safety.fhwa.dot.gov/tools/data_tools/fhwasa1140/

http://safety.fhwa.dot.gov/tools/data_tools/fhwasa1139/fhwasa1139.pdf

<http://www.fhwa.dot.gov/publications/publicroads/13mayjun/03.cfm>

<http://www.unb.ca/research/transportation-group/road-safety/guidelines.html>

<https://www.onlinepublications.austroroads.com.au/items/AP-R420-13>

<http://casr.adelaide.edu.au/staff/?pid=1165>

http://www.fiafoundation.org/publications/Documents/road_safety_in_france.pdf

https://cbrcc.curtin.edu.au/reports_journal_articles/aap%2031%20243-252.pdf

<http://www.ors.wa.gov.au/Documents/Strategies/ors-towards-zero-strategy.aspx>

<http://www.ors.wa.gov.au/Documents/Strategies/ors-towards-zero-strategy.aspx>

http://c-marc.curtin.edu.au/local/docs/CMARC_Fact_Sheet1.pdf

<http://www.ors.wa.gov.au/Documents/Strategies/ors-towards-zero-strategy-development.aspx>

<http://www.ors.wa.gov.au/Documents/Strategies/ors-towards-zero-discussion-paper.aspx>

<http://conf.tac-atc.ca/english/annualconference/tac2013/session5/rempel.pdf>

<http://alk.tiehallinto.fi/julkaisut/pdf/4000423e-veffectsofroadside.pdf>

http://www.worldbank.org/transport/roads/saf_docs/campaign.pdf

http://www.carrsq.qut.edu.au/publications/corporate/road_safety_advertising_fs.pdf

http://www.google.ca/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CCkQFjAA&url=http%3A%2F%2Fwww.nhtsa.gov%2Fstaticfiles%2Fnti%2Fpdf%2F811727.pdf&ei=hDcKU-eeHl_ioATExIKgAg&usq=AFQjCNHbqpoHXfbgZvFYiOiPggoYegnHw&sig2=reecU5u191Jd9e8OhGt2CA&bvm=bv.61725948,d.cGU

<http://www.ieg-america.com/pdf/Automated%20Traffic%20Enforcement%20Technology%20Guidelines.pdf>

<http://www.assembly.ab.ca/lao/library/egovdocs/2006/alsg/153430.pdf>

https://www.solgps.alberta.ca/programs_and_services/public_security/peace_officers/Publications/Automated%20Traffic%20Enforcement%20Guidelines%20-%202008.pdf

<http://www.assembly.ab.ca/lao/library/egovdocs/2006/alsg/153430.pdf>

<http://www.iowadot.gov/traffic/pdfs/automatetrafficenforecementguidelines.pdf>

<https://www.ma.utexas.edu/users/blumberg/automated-enforcement.pdf>

http://www.google.ca/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=34&ved=0CDgQFjADOB4&url=http%3A%2F%2Froad-network-operations.plarc.org%2Findex.php%3Foption%3Dcom_docman%26task%3Ddoc_download%26gid%3D547%26lang%3Den&ei=VzsKU5OOFNLEoASq1oCADA&usq=AFQjCNGLmi5J1M5tvdNiUclb1Dy6CLUotQ&sig2=ZFdxduZlrx1TG-jKDajxg

http://www.balticroads.org/downloads/28BRC/104_T06.pdf

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_729.pdf

http://ftp.dot.state.tx.us/pub/txdot-info/trf/red_light/auto_traffic.pdf

<http://itd.idaho.gov/ohs/HSP/FFY2014HSP.pdf>

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_746.pdf

<https://www.thunderbaypolice.ca/sites/default/files/pdfs/Traffic%20Enforcement%20and%20Safety%20Plan%202013.pdf>

http://www.piarc.org/ressources/documents/actes-seminaires06/c31-togo06/8712,togo_2006_Hollo.pdf

http://www.crash-network.com/Download/Crash_Analysis_Criteria_1.6.2.pdf

<http://www.ctre.iastate.edu/pubs/traffichandbook/5CrashAnalysis.pdf>

<http://ntl.bts.gov/lib/25000/25000/25079/AZ537.pdf>

<http://web.pdx.edu/~bertini/papers/crash.pdf>

https://www.google.ca/?gfe_rd=cr&ei=XOQKU_oNuiBmAKyv4C4Cg#q=University+of+Maryland+-+Vehicle+Accident+Analysis+-+BUDT+733

<http://www.ktc.uky.edu/projects/analysis-of-traffic-crash-data-in-kentucky/>

<https://connect.ncdot.gov/resources/safety/Documents/TEAAS/Chapter%2015%20Analysis%20Techniques.pdf>

<http://library.oregonmetro.gov/files/safetyplan/2006CodeManualVersion1.0.pdf>

<http://www-nrd.nhtsa.dot.gov/Pubs/811754AR.pdf>

<https://osha.europa.eu/en/publications/e-facts/efact02/view>

http://www.etsc.eu/documents/PRAISE_ROAD_SAFETY_MANAGEMENT.pdf

http://www.dot.ca.gov/dist4/nilescanyon/docs/sr84_va_study_final.pdf

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_492.pdf

http://www.isprs.org/proceedings/XXXVIII/4-W13/ID_54.pdf

http://www.intrans.iastate.edu/reports/souleyrette_low_vol_report_w_cvr.pdf

http://safety.fhwa.dot.gov/local_rural/training/fhwasaxx1210/lrro_data.pdf

<http://casr.adelaide.edu.au/rsr/RSR2009/RS094023.pdf>

<http://www.cph.org.uk/wp-content/uploads/2012/08/road-traffic-accidents-a-review-of-evidence-for-prevention.pdf>

http://www.ghdcanada.com/pdf/Enhancing_Road_Safety_Management_with_GIS_Mapping_and_Geospacial_Database.pdf

11-CS-1 Engineering Economics**Primary Text**

Fraser, Niall; Jewkes, Elizabeth; Bernhardt, Irwin and Tajima, May. Global Engineering Economics: Financial Decision Making for Engineers. Fourth edition, Pearson Education Canada, 2008. ISBN: 978-0132071611.

Additional Resources

Sonyi, Andrew; Fenton, Robert and White, John. Principles of Engineering Economics Analysis. Canadian edition, Wall & Emerson Inc., 2000. ISBN: 978-0921332497.

Web Resources

Key words: engineering economics, cost engineering, financial analysis

Organizations: International Cost Engineering Council, Association of Cost Engineers, Association for the Advancement of Cost Engineering

11-CS-2 Engineering in Society – Health & Safety**Primary Text**

Brauer, Roger L. Safety and Health for Engineers. Second edition, John Wiley & Sons Inc., 2006. ISBN: 978-0471286325.

Web Resources

Key words: health and safety, public safety, engineering ethics

Organizations: Canadian Society of Safety Engineering (CSSE), Canadian Centre for Occupational Health and Safety (CCOHS), Health Canada, National Academy of Engineering Center for Engineering, Ethics and Society

11-CS-3 Sustainability, Engineering and the Environment

Mihelcic, J.R. and Zimmerman, J.B. (2014) *Environmental Engineering: Fundamentals, Sustainability, Design, 2nd edition*. John Wiley & Sons, Hoboken, NJ.

Berg, L., Hager, M.C., Goodman, L. and Baydack, R. (2010) *Visualizing the Environment* (Canadian Edition). John Wiley & Sons, Hoboken, NJ. (Chapters 10, 11)

Wimmer, W. and Kauffman, Joanne. Handbook of Sustainable Engineering. First edition, Springer Publishing, 2011. ISBN: 978-1-4020-8939-8.

Additional Resources

The Report of the Brundtland Commission (“Our Common Future”)
1972 Stockholm Report of the United Nations Conference on the Human Environment
1992 United Nations international Earth Summit in Rio de Janeiro

Web Resources

Key words: Sustainability; Sustainable engineering; Energy, Engineering and the Environment

Organizations: Environment Canada, Natural Resources Canada, Organisation for Economic Co-operation and Development (OECD) sustainable development

11-CS-4 Engineering Management**Primary Text**

American Society for Mechanical Engineers. Guide to the Engineering Management Body of Knowledge. American Society for Mechanical Engineers, 2010. ISBN: 978-0791802991

Additional Resources

Gray, Clifford F. and Larson, Erik W. Project Management: The Managerial Process. Canadian 5th edition. Irwin/McGraw-Hill, 2011. ISBN: 978-0073403342

aussi disponible en français :

Gray, Clifford F. et Larson, Erik W. Management du projet. Chenelière McGraw-Hill, 2006. ISBN: 978-2765104537

Web Resources

Key words: engineering management, financial management, strategic management, resource management, operations management

Organizations: American Society for Mechanical Engineers (ASME), Canadian Society for Engineering Management, Project Management Institute, American Society for Engineering Management

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07-TRA-A3	Traffic Engineering
07-TRA-A4	Pavement Materials, Design and Management
07-TRA-A5	Transportation Planning and Demand Analysis
07-TRA-A6	Geotechnical Materials and Analysis

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07-TRA-B3	Logistics and Goods Movement
07-TRA-B4	Air Transportation
07-TRA-B5	Railway Transportation
07-TRA-B6	Highway Construction
07-TRA-B7	Transportation Economics
07-TRA-B8	Operations Research
07-TRA-B9	Traffic Safety
07-TRA-B10	Geomatics

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11-CS-2	Engineering in Society – Health & Safety
11-CS-3	Sustainability, Engineering and the Environment
11-CS-4	Engineering Management
3.2	Engineering Report

