

University of Toronto
Faculty of Applied Science and Engineering

APS111 Engineering Strategies and Practice

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Final Examination

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This is a 2.5 hour exam and is closed book. For the multiple choice portion please read each question thoroughly and provide the best answer on the answer card. Be sure to fill out the answer form clearly with no overlap. Fill out the answer card using a number 2 pencil. Erase any errors completely. Each question is worth 1 mark. One answer per question. The writing component is worth 13 marks (approximately 20% of the total mark).

- 1) The first mechanized mode of public transit used in North American cities was:
 - (a) Bus
 - (b) Streetcar
 - (c) Subway
 - (d) Taxi
 - (e) Horsecar
- 2) Consider the following 3 statements then choose among a, b, c and d:
 - (i) The rise of road congestion leads to urban sprawl
 - (ii) Urban sprawl contributes to more road congestion
 - (iii) Urban sprawl is not an important issue in North America
 - (a) Only (i) is true
 - (b) Only (ii) is true
 - (c) None of (i) and (ii) is true
 - (d) Both of (i) and (ii) are true
 - (e) Both of (ii) and (iii) are true
- 3) A stakeholder is?
 - (a) Any person, organization or entity that has a stake in the engineering artifact
 - (b) Any person that has a stake in the engineering artifact
 - (c) Any entity that has a stake in the engineering artifact
 - (d) Any government organization that has a stake in the engineering artifact
 - (e) Any design team member that is holding a steak

- 4) Broader design constraints are
- (a) The same as technical constraints
 - (b) Related to non-stakeholders of the design
 - (c) Related to stakeholders other than the client and immediate users of the product
 - (d) Related to financial and other constraints to the design company
 - (e) a and d
- 5) The different stakeholders of the same product design
- (a) Always have the same objective
 - (b) Have different objectives that define the functions but not the constraints of the design
 - (c) Have different objectives that do not conflict with one another
 - (d) Have different objectives, some of which usually conflict with one another
 - (e) b and d
- 6) In the toilet paper case study, which of the following stakeholders would be concerned about the economics of the product?
- (a) Users
 - (b) Pulp suppliers
 - (c) Retailers
 - (d) Operating workers
 - (e) All of the above
- 7) Which categories best apply to the sewer and water authority in the toilet paper case study?
- (a) \$
 - (b) HF, SI, EI
 - (c) \$, EI, SI
 - (d) \$, SI
 - (e) HF, SI, \$, EI
- 8) What is the main chemical process in the manufacturing of toilet paper?
- (a) Bleaching
 - (b) Carbonization
 - (c) Combustion
 - (d) Chemical synthesis
 - (e) None of the above
- 9) What is the effect of incorporating broader constraints in the design process?
- (a) It creates feedback loops in the design process
 - (b) It usually results in compromise solutions
 - (c) It may give rise to ethical issues
 - (d) a, b and c

(e) a and b

10) After identifying all objectives and constraints of the design, how do you proceed with the design process?

- (a) Identify stakeholders
- (b) Start the conceptual design
- (c) Assign weights to the objectives and constraints, and seek feedback from stakeholders
- (d) a and b
- (e) None of the above

11) In the St. Clair Ave. Transit Design Study, the objectives and constraints were grouped in which of the following categories?

- (a) Transportation, costs, construction and natural environment
- (b) Costs, environment, society, human factors
- (c) Community and business, human factors, life cycle, transportation
- (d) Ethics, human factors, social and construction
- (e) Transportation, costs, community/business and natural environment

12) The main purpose of the conceptual design stage is to

- (a) Generate design alternatives and evaluate them against objectives and constraints
- (b) Obtain concepts from stakeholders to design the engineering artifact
- (c) Develop specifications for the detailed design stage
- (d) Identify the functions and objectives of the design
- (e) None of the above

13) Statutory law is based on:

- (a) Common law
- (b) Laws which are commonly known
- (c) Municipal laws
- (d) Laws created by a legislative body
- (e) Court decisions

14) A tort

- (a) Is a liability
- (b) Is a civil wrong involving damage to a person
- (c) Includes fraud
- (d) None of the above
- (e) a, b and c

15) Most professional dilemmas occur in situations that are

- (a) Legal and ethical
- (b) Illegal but ethical

- (c) Legal but unethical
 - (d) Illegal and unethical
 - (e) a and c
- 16) The PEO code of ethics describes the paramount duty of an engineer as the one to
- (a) The client
 - (b) The Engineering profession
 - (c) Public welfare
 - (d) Oneself
 - (e) The employer
- 17) The duty of an engineer towards his/her colleague includes
- (a) Covering up his/her professional mistakes
 - (b) Avoiding unfair competition
 - (c) Reviewing and reporting his professional performance when asked by the manager
 - (d) a, b and c
 - (e) b and c
- 18) Moonlighting is
- (a) Working during off-hours on the employer's projects, but without financial compensation
 - (b) Providing services during off-hours to entities other than one's employer
 - (c) Working overtime at late hours at the office and getting rewarded by the employer
 - (d) The employer's right to ask their employees to stay long hours if they have not completed their tasks during regular work hours
 - (e) a and d
- 19) How did the group of engineers involved in the problems of the launch of the space shuttle *Challenger* in 1986 resolve their ethical dilemmas?
- (a) They declared their conflict of interest
 - (b) They resigned
 - (c) They did their best to solve the technical problem and remained silent after they failed
 - (d) They engaged in whistleblowing
 - (e) a and b
- 20) The engineer's duty to society does not include
- (a) *Pro bono* services
 - (b) Protecting life, health and property
 - (c) a duty to be helpful to society
 - (d) a and c
 - (e) b and c

- 21) What term describes this ethical issue: an engineer works for a company and he awards a high-paying design project to his brother without telling his manager of the family relationship between him and his brother?
- (a) Unfaithful agency
 - (b) Failure to report
 - (c) Negligence
 - (d) Nepotism
 - (e) Conflict of interest
- 22) Global warming is caused by:
- (a) The combustion of fossil fuels
 - (b) The emission of carbon dioxide
 - (c) The emission of methane
 - (d) Greenhouse gas emissions
 - (e) All of the above
- 23) Eutrophication causes
- (a) Excessive plant growth and oxygen depletion
 - (b) Building corrosion
 - (c) Increased morbidity and mortality
 - (d) Polar melting
 - (e) Ultraviolet radiation
- 24) Which of the following has a global environmental impact beyond the regional/local geographic domain?
- (a) Photochemical smog
 - (b) Ozone depletion
 - (c) Land use
 - (d) Terrestrial toxicity
 - (e) Acidification
- 25) The stages of life cycle assessment do not include
- (a) Identifying scope and life cycle
 - (b) Impact analysis
 - (c) Implementation planning
 - (d) Improvement analysis
 - (e) Inventory analysis
- 26) What are two factors that engineers always must consider when analyzing a selected engineering process in any full life cycle assessment?
- (a) Energy and labour
 - (b) Cost and packaging

- (c) Transport and environment
 - (d) Residuals and energy
 - (e) None of the above
- 27) Determining environmental impacts requires the knowledge of
- (a) Environmental reactions
 - (b) Toxicology of materials
 - (c) Transport phenomena
 - (d) a and b
 - (e) a, b and c
- 28) Which of the following provides the best example(s) of pollution prevention when considering a facility that produces automotive tires?
- (a) Redesign product
 - (b) Reduce residuals production
 - (c) Recycle wastes
 - (d) a and b
 - (e) a, b and c
- 29) The price of an engineering product in the market is determined by
- (a) Law of supply alone
 - (b) Law of demand alone
 - (c) Expenses and costs incurred by the producer
 - (d) a, b and c
 - (e) Interaction between supply and demand
- 30) The total cost of an engineering product is equal to
- (a) Fixed costs plus operating costs
 - (b) Fixed costs plus capital costs
 - (c) Operating costs plus marginal costs
 - (d) Variable costs minus marginal costs
 - (e) None of the above
- 31) Economy of scale exists when
- (a) Price per unit increases as the production level increases
 - (b) Marginal cost decreases as the production level increases
 - (c) Average cost increases as the production level increases
 - (d) Total costs increases as the production level increases
 - (e) None of the above

32) A company can maximize profit from the sale of its product if

- (a) The average cost is minimized
- (b) The price is set higher than competitive products
- (c) The marginal revenue is equal to the marginal cost
- (d) The marginal cost is minimized
- (e) a and b

33) According to the concept of the time value of money,

- (a) The value of a dollar today is worth less than a dollar next year
- (b) There is no long-term risk to you if you keep your money without investment
- (c) Investing a certain amount now will grow the value of that amount over time
- (d) a and b
- (e) b and c

34) The discount rate

- (a) Captures the risk and opportunities associated with transactions over time
- (b) Is opposite in concept to the interest rate
- (c) Shows the value today of money that will be available at some point in the future
- (d) Is used to compute the Present Value
- (e) All of the above

35) Assuming a discount rate of 5%, the present value of a \$100 revenue you expect to make in 3 years is

- (a) \$100
- (b) \$86.4
- (c) \$115.8
- (d) \$115
- (e) none of the above

36) What was the problem faced by Leonid Toptunov in the Chernobyl disaster?

- (a) His shift was too late at night and he slept
- (b) The nuclear power station was understaffed and he could not cope with the unfolding disaster
- (c) He was not informed of the experiment taking place at the nuclear power station
- (d) The consoles in the control room provided overwhelming data but not enough information
- (e) He did not have the expertise to conduct the test

37) In his 1943 inquiry of the B-17s, B-25s and P-47s, Lieutenant Alphonse Chapanis found

- (a) Identical controls of landing gear and flaps were placed close to each other
- (d) Pilots were not well trained
- (c) The engineering design of the landing gear was faulty

- (d) The investigated problem was common to all warplanes
(e) c and d
- 38) In the design of engineering products, there is a current disconnect between
(a) The technology and users
(b) The humanistic view and mechanistic view
(c) The designer and the client
(d) a and c
(e) a, b and c
- 39) At the bottom of the Human-Tech Ladder is
(a) The organizational human factors
(b) The team human factors
(c) The base of the ladder
(d) The technological advancements
(e) The physical human factors
- 40) The emergent property
(a) Defines the intangible relationship between system elements
(b) Is a property of a chemical compound
(c) Is a human value
(d) a and c
(e) None of the above
- 41) Which sentence uses “affect” or “effect” **correctly**?
(a) The committee may never know the full affect of the radiation leak.
(b) An early frost will affect the crops.
(c) The media has a strong affect on public opinion.
(d) Pollution effects everybody.
(e) None of the above.
- 42) Which sentence is grammatically **correct**?
(a) The use of insecticides often result in unfortunate side effects.
(b) The use of insecticides often cause unfortunate side effects.
(c) The use of insecticides often results in unfortunate side effects.
(d) The use of insecticides often bring about unfortunate side effects.
(e) (a) and (c)
- 43) In which sentence are numbers indicated **correctly**?
(a) On Tuesday, 4 orders were delivered.
(b) Before the meeting, there was a 5-minute delay.
(c) The trial lasted for thirty hours.
(d) There are 14 12-part packets in the set.
(e) None of the above.

- 44) A semicolon is used
- (a) To introduce a list.
 - (b) To separate items in a series that also contains commas.
 - (c) Between independent clauses joined by a coordinating conjunction.
 - (d) Between independent clauses joined by a conjunctive adverb.
 - (e) b and d
- 45) Which of the following is grammatically **incorrect**:
- (a) The new edition is more up-to-date; however, it is also more expensive.
 - (b) The new edition is more up-to-date, but it is also more expensive.
 - (c) The new edition is more up-to-date. It is also more expensive.
 - (d) The new edition is more up-to-date, and it is also more expensive.
 - (e) The new edition is more up-to-date, it is also more expensive.
- 46) Identify the grammatically **correct** sentence:
- (a) The team discovered a potential problem; schedule conflicts.
 - (b) The team discovered a potential problem. Schedule conflicts.
 - (c) The team discovered: a potential problem, schedule conflicts.
 - (d) The team discovered a potential problem: schedule conflicts.
 - (e) None of the above.
- 47) Identify the grammatically **correct** sentence:
- (a) The team suggested Robert and me complete the Executive Summary.
 - (b) Robert and me completed the Executive Summary.
 - (c) The Executive Summary was completed by Robert and I.
 - (d) The team suggested Robert and I complete the Executive Summary.
 - (e) None of the above.

Questions 48-50 are based on the paragraph below.

1 Our company has a strong commitment, to environmental and social
2 causes. For example, we have a number of programs to help
3 consumers recycle or reuse (e.g. donate to charity) items such as left
4 over paint, or kitchen countertops that are removed during renovations.
5 One item that currently poses a hazard for disposal is: compact
6 fluorescent light bulbs. Although these bulbs are energy efficient, they
7 contain mercury and, if disposed of in the regular trash, pose an
8 environmental hazard. We would like to set up a recycling or safe
9 disposal system for compact fluorescent bulbs that could be
10 implemented in one of our thirty stores across North America. We feel
11 this would reinforce our corporate image as an environmentally friendly
12 company, and this would also give customers another incentive for
13 visiting our stores.

- 48) The sentence beginning on line 1
- (a) Uses a pronoun incorrectly
 - (b) Uses a comma incorrectly
 - (c) Should use a semicolon instead of a comma
 - (d) Uses a comma correctly
 - (e) a and c
- (49) The sentence beginning on line 5
- (a) Should use a comma instead of a colon
 - (b) Should use a semicolon instead of a colon
 - (c) Should use a period instead of a colon
 - (d) Uses the colon correctly
 - (e) None of the above
- (50) The sentence beginning on line 8 and ending on line 10
- (a) Should use a colon after "implemented"
 - (b) Should use a semicolon after "implemented"
 - (c) Should change "thirty" to "30"
 - (d) Should change "one" to "1"
 - (e) Requires no revision

This question requires a written answer. Please use an exam booklet. You may use as many pages as you need for your rough work, but the **final answer must be no more than two (2) pages**. **Please use single-space bullet lists and double-space paragraph(s) in your final answer.** Clearly indicate the final copy to be graded by writing “**FINAL COPY**” at the start of it.

CLIENT STATEMENT:

The 506 Carlton Streetcar line stretches along Carlton St. and College St. and serves about 33,000 passengers per day. Currently, the streetcars travel in the centre lanes that are also shared with the general traffic, causing significant delays to the streetcars because of the growing traffic volume. Also, the current centre-lane operation poses a safety hazard to passengers, who must cross the right lane in order to get on or off any streetcar. These passengers risk collision with cars and bicycles in the space between the streetcar and the sidewalk. The Toronto Transit Commission (TTC) would like to improve the streetcar operation relative to the private automobile. It is desired to enhance the performance and safety of the 506 Carlton Streetcar line, taking into consideration the concerns of all stakeholders.

Many streetcar users, in addition to complaining about safety, complain to the TTC about the inconvenient design of current streetcars. Not only does the streetcar have an awkward interior design, but the four steps people have to negotiate in order to get on or off any streetcar is a major inconvenience, particularly to old and sick people, young children, and people carrying baggage. In fact, many such people do not currently use streetcars for these reasons. These limitations are particularly relevant to the 506 Carlton Streetcar line, which runs near a concentration of hospitals (at College St. and University Ave.) and many daycare and school facilities spread along the line. Additionally, the line travels by many individual commercial shops as well as the large shopping concentration of Chinatown. The accessibility and convenience of the streetcar vehicles and stops for use by all customers are of high importance in this project.

Traveling by streetcars (and transit vehicles in general) is now considered by all planners and engineers as a “green” method of travel, much similar to biking and walking. These three modes (transit, biking and walking) are considered “green” because they pose much less threat to the environment than traveling by car, which emits greenhouse gases and other particulate matter. The focus of most transportation engineering projects is to enhance and promote the attractiveness of these three modes relative to the car. Currently, a section of College St. includes a dedicated bicycle lane immediately adjacent to the sidewalk, and this lane provides bicycle riders with a safe and efficient pathway, thus encouraging many people to use it. In fact, many University of Toronto students and professors use this lane in their commute to and from the university everyday. Any improvement to the transit streetcar operation must not adversely impact bicycle traffic. Similarly, protecting and enhancing the sidewalk conditions for pedestrian traffic along College St. is an important goal of the streetcar improvement project.

The construction associated with implementing any improvements to the 506 Carlton Streetcar line will possibly affect the traffic circulation in the neighbouring areas to College and Carlton streets. Access to and from residential neighbourhoods and stores along or near

those streets may be adversely affected. Additionally, the safety of construction workers is an important consideration.

INSTRUCTIONS:

In a bullet list, identify the stakeholders and their concerns for this project. To assist you in building a list of stakeholders, refer below to Figure 1: The 506 Carlton Streetcar Line. Then, using this list of stakeholders as a guide, write a concise Problem Definition that includes a Problem Statement, written in one or two unified paragraphs, followed by a list of Functions, Objectives, and Constraints.

Assume that this is the first section of a longer report, and observe the conventions that we have followed during the term when writing a Conceptual Design Specification: the problem definition must be solution-independent; written in your own words; and include headings, subheadings, and introductory statements where appropriate.

Once again, for this answer, the bullet lists must be single-spaced, and the paragraph(s) must be double-spaced. The entire answer must be no longer than two pages.

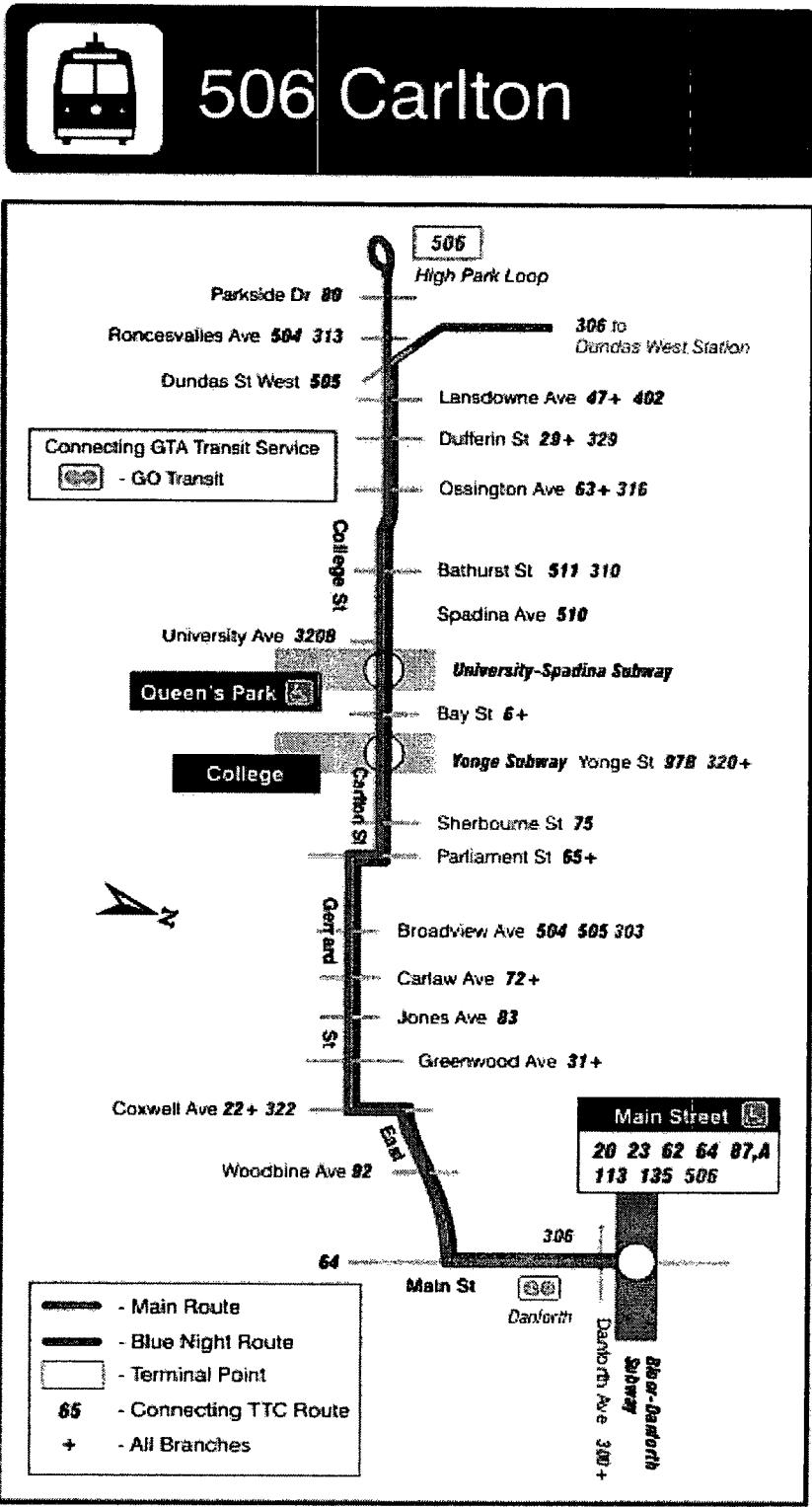


Figure 1: The 506 Carlton Streetcar Line