University of Toronto

Faculty of Applied Science and Engineering

Final Examination, December 2008

Duration: 2.5 hours

APS111H1F - Engineering Strategies and Practice 1

Calculator Type: 4 (No electronic or mechanical devices permitted)

Exam Type: A (No aids permitted)

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Instructions:
This is closed book exam; no aids are permitted. There are two parts of the exam: multiple-choice questions and a writing component. Read each question carefully.

For the multiple-choice portion, provide the best answer to each question on the answer card. **Only one answer is to be given for each question**. Be sure to fill out the answer form clearly with no overlaps, using a number 2 pencil. Erase any errors completely. There are a total of 46 multiple-choice questions, each of which is worth about 1.5 marks, for a total of 70 marks, of 70% of the exam.

The second part of the exam is a writing component worth 30% of the exam. Answer this part in the exam booklet carefully following the instructions.

Part 1: Multiple-choice questions (70%)

1) "Sustainable development" is commonly defined as
   (a) "development that continuously provides for the needs of people."
   (b) "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
   (c) "development that provides for continuous economic growth."
   (d) "development that provides economical housing for all peoples in developing countries."
   (e) None of the above

2) The "pillar(s)" or main element(s) of sustainable development are a healthy or excellent:
   (a) economy
   (b) environment
   (c) economy and reliability
   (d) economy, environment and efficiency
   (e) economy, environment and society
   (f) a and b
   (g) b and c

3) A stakeholder is:
   (a) any person that has an interest in the engineering artifact
   (b) any group that has an interest in the engineering artifact
   (c) any organization that has an interest in the engineering artifact
   (d) a and b
   (e) a and c
   (f) b and c
   (g) a, b and c

4) In addition to the client and users, stakeholders in the design of a new paper mill include:
   (a) local environmental groups
   (b) mill workers
   (c) endangered species potentially affected by emissions from the mill
   (d) a and b
   (e) a and c
   (f) b and c
   (g) a, b and c

5) NGO is the acronym for:
   (a) No growth organization
   (b) Non-governmental organization
   (c) Non-government opportunity
   (d) No growth opportunity
   (e) None of the above

6) To address the broader concerns of stakeholders, the following is or are generally needed:
   (a) Consultation with stakeholders
   (b) Interdisciplinary design teams including engineers
   (c) A single broadly educated engineer
   (d) a and b
   (e) a and c

7) The final feasible design alternatives are the CDAs that are suggested by the client and meet all the functions and constraints set by the client and
   (a) meet all of the objectives of the client
   (b) additional CDAs suggested by other stakeholders
   (c) meet all of the other stakeholders' constraints
   (d) meet all of the other stakeholders' constraints that are acceptable to the client
   (e) a and c
   (f) b and c
   (g) b and d

8) The preferred feasible design alternative is the one that:
   (a) is the least expensive
   (b) best meets the objectives of the client and users
   (c) best balances the objectives of the client, users and other stakeholders
   (d) a and b
   (e) a and c
   (f) None of the above

9) Which of the following is NOT true:
   (a) The service environment constrains design decisions
   (b) A design can affect the service environment
   (c) The service environment includes physical conditions
   (d) The service environment includes socio-economic conditions
   (e) The service environment includes other related equipment
   (f) None of the above

10) Neither the humanistic nor the mechanistic views alone can clearly see the relationship between
   (a) people and the study of mechanical engineering
   (b) people and technology
   (c) the arts and engineering
   (d) religion and technology
   (e) None of the above

11) Which of the following is an example of a problem from NOT properly designing for the "human factor"?
   (a) Chernobyl nuclear accident
   (b) Preventable hospital deaths
   (c) Frustration with electronic features in automobiles
   (d) Ambulance delays from automated dispatch system
   (e) a and b
   (f) c and d
   (g) All of the above

12) Engineering design should
   (a) fit technology to human nature
   (b) fit human nature to technology
   (c) balance the needs of technology and human nature
   (d) not consider human nature
   (e) None of the above

13) Systems thinking is an approach that focuses on
   (a) the use of computer systems for engineering design
   (b) relationships and interactions between elements of the design
   (c) the systematic thoughts of humans
   (d) All of the above
   (e) None of the above

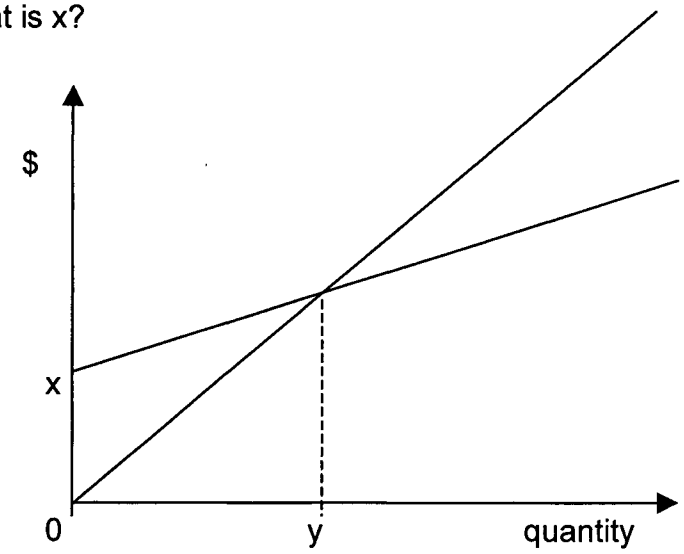
14) Which of the following is NOT one of the five levels of the Human-tech ladder?
(a) Physical
(b) Organizational
(c) Team
(d) Economical
(e) Political
(f) d and e
(g) None of the above

15) Which of the following is an example of the issues addressed in the psychological level of the Human-tech ladder?
(a) Reward structure
(b) Responsibilities
(c) Information content
(d) a and b
(e) a and c
(f) b and c
(g) a, b and c

16) The best alternative from an economic perspective is the one that has the minimum costs when
(a) the benefits are the same for all alternatives
(b) the discount rate is 0
(c) all alternatives have the same lives
(d) the disposal costs are the same for all alternatives
(e) None of the above

17) In this figure of revenues and costs, what is x?
(a) Fixed revenues
(b) Fixed costs
(c) Variable costs
(d) Initial costs
(e) Operating costs
(f) None of the above

18) In this figure, what is y?
(a) Quantity that will be sold
(b) Quantity that will be demanded
(c) Maximum required quantity
(d) Breakeven quantity
(e) None of the above



19) Which of the following is a variable cost of driving a car?
(a) Car registration/licence
(b) Car loan payments
(c) Gasoline
(d) Monthly cost for parking space at apartment
(e) None of the above

20) Ongoing costs include:
(a) operating and maintenance costs
(b) distribution costs
(c) overhead costs
(d) a and b
(e) a and c
(f) b and c
(g) a, b and c

21) An old machine can be replaced by a more efficient machine that has an initial cost of $500 and that reduces operating costs by $100 per year. What is the payback period of this new machine?
(a) 0.2 years
(b) 1 year
(c) 5 years
(d) 6 years
(e) None of the above
(f) There is not enough information to answer this question

22) Given the following information about two feasible designs:

	Initial cost	Annual revenue	Annual cost	Disposal cost
Design A	$2000	$500	$200	$100
Design B	$3000	$700	$300	$100

$r > 0\%$
Life of both designs = 10 years

Which design is better economically?

(a) Design A is better than Design B
(b) Design B is better than Design A
(c) Design A and B are equally good
(d) None of the above
(e) There is not enough information to answer this question

23) External costs are costs that are paid by the:
(a) producer
(b) users
(c) society
(d) a and b
(e) a and c
(f) b and c
(g) a, b and c

24) Cumulative impacts are generally
(a) effects that are the result of numerous small actions
(b) effects that are the result of one large action
(c) important to address
(d) a and c
(e) b and c

25) Which of the following is the best strategy to design for sustainability?
(a) Pollution prevention
(b) Pollution control
(c) Materials recovery
(d) Industrial ecology
(e) a and b

26) Eco-efficiency involves producing goods and services
(a) inexpensively (economically)
(b) in natural (ecological) ways
(c) by minimizing waste and recycling and reusing materials
(d) by reducing energy and pollution
(e) a and b
(f) c and d
(g) All of the above

27) Which of the following is NOT included in the principles of industrial ecology?
(a) only natural (ecological) systems are used for production
(b) residuals from one process are used as inputs to another process
(c) design products so that they can be reused
(d) minimize use of energy
(e) work with suppliers to minimize packaging
(f) None of the above

28) Designing to mitigate climate change includes:
(a) more energy efficient buildings
(b) stronger structures
(c) use of new energy technologies
(d) a and b
(e) a and c
(f) b and c
(g) a, b and c

29) The steps of a life-cycle assessment do NOT include
(a) impact analysis
(b) improvement analysis
(c) implementation analysis
(d) inventory analysis
(e) None of the above

30) The inputs considered in a life-cycle assessment do NOT include
(a) raw materials
(b) labour
(c) land
(d) water
(e) energy
(f) None of the above

31) The outputs that should be considered in a life cycle assessment include
(a) pollution
(b) usable products
(c) nonusable products
(d) a and b
(e) a and c
(f) b and c
(g) a, b and c

32) A life-cycle diagram is done as part of what step in an LCA?
(a) impact analysis
(b) improvement analysis
(c) implementation analysis
(d) inventory analysis
(e) None of the above

33) Carbon footprint analysis estimates the following:
(a) amount of carbon used in a production process
(b) amount of carbon emitted in a process based on industrial ecology principles
(c) amount of carbon reduced through eco-efficiency measures
(d) amount of carbon in the footprint of stakeholders
(e) amount of greenhouse gases emitted in the life cycle of a product or process
(f) amount of carbon emitted from a greenhouse

34) An LCA for toilet paper that would have a manageable scope would NOT include which of the following?
(a) Transportation of the pulp to the paper mill
(b) Wastewater (sewage) treatment
(c) Forest harvesting
(d) Manufacturing of chain saws to cut trees
(e) a and b
(f) a and c

35) Sensitivity analysis is a method for:
(a) analyzing the sensitivity of people to pollutants
(b) analyzing the sensitivity of stakeholders' views about alternative designs
(c) analyzing the sensitivity of an analysis to changes in the values of uncertain parameters
(d) analyzing the sensitivity of endangered species to the effects of engineering designs
(e) None of the above

36) Which of the following are social factors that would be affected by introducing the Web (Internet) to an area?
(a) Social interactions
(b) Religion
(c) Education
(d) Political power
(e) a and b
(f) c and d
(g) All of the above

37) Which of the following would likely be a social impact resulting from the banning of waste pickers from landfills in developing countries?
(a) More children would go to school
(b) More women would be unemployed
(c) Family incomes would increase
(d) a and b
(e) a and c
(f) b and c
(g) a, b and c

38) The design of which of the following does NOT have a potentially significant social impact?
(a) Slot machines
(b) Cell phones
(c) Water treatment plant
(d) Hydroelectric plant
(e) None of the above

39) To compare design alternatives, which of the following is correct?
(a) There is a need to estimate how well each alternative meets each objective in terms of quantitative metrics.
(b) There will often be conflicts between stakeholders over the choice of preferred design.
(c) There will be little uncertainty about how well each alternative meets each objective if sufficient money is spent on the estimation.
(d) All objectives need to be considered.
(e) a and b
(f) c and d
(g) a, b, c and d

40) Which of the following is correct?
(a) Different objectives will usually have different degrees of importance for a particular stakeholder
(b) The relative importance of the objectives will generally be different for different stakeholders
(c) All objectives will be relevant to all of the stakeholders
(d) a and b
(e) a and c
(f) b and c
(g) a, b and c

41) Consider the table below showing the ratings (on a scale of 0 to 10, where 10 is best) and weights (on a scale of 0 to 100) for the two objectives for two designs:

		Ratings for	
	Weight	Design A	Design B
Objective 1	60	2	3
Objective 2	40	9	8

What can you conclude about the two alternative designs?
(a) Design A is better than Design B
(b) Design B is better than Design A
(c) Design A and Design B are equally good
(d) None of the above
(e) There is not enough information to answer this question

42) Which of the following is NOT a definition of "ethics"?
(a) the discipline dealing with what is good and bad and with moral duty and obligation
(b) a theory or system of moral values
(c) a set of moral principles or values
(d) a set of codes of conduct
(e) the principles of conduct governing an individual or group

43) In which one of the following cases did the engineers involved clearly act ethically?
(a) Ford Pinto
(b) Citicorp Centre building
(c) Challenger space shuttle
(d) Procurement of C-5A cargo planes
(e) None of the above

44) Whistleblowing is:
(a) a government employee informing the news media about a corrupt politician
(b) the act of blowing a whistle so loudly that it hurts another person's hearing
(c) someone telling others about another person's actions in order to stop a faulty decision that is or was being made
(d) an engineer informing the client about a way to make a design safer
(e) an engineer informing their professional association about an unethical client
(f) None of the above

45) Professional Codes of Ethics in the US and Canada typically have the following in common?
(a) emphasizing integrity and honesty
(b) protection of whistleblowers
(c) guidelines or standards on how to behave with respect to clients, the profession, the law, and the public
(d) a and b
(e) a and c
(f) a, b and c

46) Which of the following creates a legal constraint for design decisions?
(a) professional code of ethics
(b) regulations
(c) guidelines
(d) a and b
(e) a and c
(f) b and c
(g) a, b and c

Part 2: Written Problem Definition (30%)

INSTRUCTIONS: This question requires a written answer. Use an exam booklet, and write in your name, student number, course, and date of examination on the booklet's cover page. You may use as many pages as you need for your preliminary work, but the final answer must be no more than three (3) pages. Clearly indicate the final copy to be graded by writing "Final Copy" at the start of it.

In your exam booklet, write a concise Problem Definition based on the following client statement. The Problem Definition should include each of the sections and subsections that were required for the Problem Definition in the CDS Individual Assignment. Use headings, subheadings, paragraphs, and bullet lists where appropriate.

CLIENT STATEMENT: From the University of Toronto Administration

The University wishes to be more environmentally progressive and to advance sustainability. With over 40 cafeterias and restaurants serving the University community (students, faculty and staff) on the St. George campus, and with people bringing food from home, the University estimates that approximately 1 tonne of organic waste (uneaten food) is generated each day by this community. Currently, this organic waste is collected with all of the un-recycled waste by the university cleaning staff and then transported by a private company for disposal in a landfill. Instead, the University would like to develop a system to separate the organic waste from the un-recycled waste so that it can later be turned into compost to be used as a fertilizer by the University's Physical Plant (lawns keepers) on the University's lawns or in nearby local gardens operated by non-profit community groups.

While the University has bins for un-recycled waste and for the separation of paper, plastics and bottles, which it wishes to continue to recycle, a system is also required for the separation of organic wastes so that this waste can be easily collected for composting. The University would like to put an organic waste recycling bin in a central location in each cafeteria, where people can put the organic waste so that it can be collected by the cleaning staff and taken to a composting facility. You have been hired to design the separation system. Whatever is done must not add significant cost to the University's budget or create unhealthy, unsightly or odourous situations. And because of rodents (mice and rats) on campus, the design must not allow rodents to get into the organic waste. Finally, in keeping with the University's interests in protecting the environment, the design should be environmentally friendly.