MIE 240 Fall 2001
Final Exam
December 13, 2001

Note: This exam is worth 100 points and will last for 150 minutes (i.e., allocate one and a half minutes per point). This is a closed book, closed notes exam. Answer all the questions in the exam, which consists of 25 multiple choice questions in Section A and all 15 short answer questions in Section B. **Write your answers to ALL the questions (including multiple choice) in the answer booklets provided. Write you name on the front of each answer booklet.**

Section A. 25 Multiple Choice Questions (25 Points).

If more than one answer appears to be correct, choose the most accurate answer. No marks will be deducted for guessing. Indicate your answer by writing the corresponding letter (a, b, c, or d) in your answer booklet.

1. In the absence of extraneous factors such as strong emotions or intake of drugs (stimulants), a heart rate of 90 beats per minute in a physically fit worker would be indicative of:
   a. light physical work
   b. medium physical work
   c. heavy physical work
   d. very heavy physical work

2. In a digit span task, people reproduce a sequence of (e.g., eight digit) numbers a few seconds after viewing or hearing them. In such a task, numbers have the best chance of being recalled if they are:
   a. at the beginning of the list
   b. in the middle of the list
   c. at the end of the list
   d. anywhere in the list (no systematic order effect)

3. The region of the dark adapted eye that is most sensitive to faint light is:
   a. The fovea
   b. 20 to 40 degrees from the centre of the retina
   c. 60 to 80 degrees from the centre of the retina
   d. in the extreme periphery of the retina

4. If a person is deprived of sleep, the circadian rhythm (e.g., variation in core body temperature over a 24 hour period) will:
   a. not be affected
   b. will tend to become more pronounced (larger peaks and valleys)
   c. will tend to become less pronounced (smaller/flatter peaks and valleys)
   d. will be more pronounced in summer and less pronounced in winter

5 Human age-related hearing losses tend to be:
   a. greater for high frequencies
   b. greater for low frequencies
   c. approximately the same across all frequencies
   d. greater in females than in males

6. Which of the following URLs specializes in providing information about usability engineering?
   a. http://hfes.org
   b. http://www.osha.gov
   c. http://www.acm.org
   d. http://www.upassoc.org

7. According to research cited by Chapanis, the difference between abilities to read highway signs for young versus old drivers is greatest in which of the following conditions?
   a. daytime under clear skies
   b. daytime under cloudy skies
   c. night-time
   d. night-time with glare

8. The comfort zone for room temperature (according to MIL-STD-1472D) tends to be:
   a. warmer in winter
   b. cooler in winter
   c. unaffected by the changing seasons
   d. varying between years rather than within years

9. The threshold sound pressure for hearing is:
   a. 20×10^{-7} Pascals
   b. 20×10^{-6} Pascals
   c. 20×10^{-5} Pascals
   d. 20×10^{-4} Pascals

10. Circadian rhythms in people fluctuate over a:
   a. 28 day cycle
   b. 7 day cycle
   c. 24 hour cycle
   d. 12 hour cycle

11. The lumbar region of the back (spine) is:
   a. above both the thoracic region and the sacral region
   b. above the thoracic region but below the sacral region
   c. above the sacral region but below the thoracic region
   d. below both the sacral region and the thoracic region

12. According to NASA-STD-3000, the threshold of discomfort for a 1000 Hz tone is approximately:
   a. 120dB
   b. 100dB
   c. 90dB
   d. 80dB

13. For cost-effective usability testing, the aim is to have the minimum number possible while still achieving reliability and accuracy. According to Nielsen and Landauer (1993), 70% of the major usability problems can typically be uncovered by a test sample of:
   a. 1 user
   b. 5 users
   c. 10 users
   d. 20 users

14. In the human brain, language functions are typically handled by:
    a. the left hemisphere
    b. the right hemisphere
    c. both hemispheres equally
    d. the brainstem

15. The basal metabolism of a typical North American male is:
    a. 1 Kcal/min
    b. 1.5 Kcal/min
    c. 2 Kcal/min
    d. 2.5 Kcal/min

16. Which part of the body is the carpal tunnel located in:
    a. knee
    b. neck
    c. elbow
    d. wrist

17. Evaporative heat loss from the surface of the body is highest in:
    a. wet (humid) slow moving or stationary air
    b. dry slow moving or stationary air
    c. wet and fast moving (windy) air
    d. dry and fast moving (windy) air

18. On a wet road surface, as vehicle speed increases, the stopping distance of the vehicle (after the brakes have been applied):
    a. increases in a straight line relationship
    b. increases in an accelerating non-linear relationship
    c. increases in a decelerating non-linear relationship
    d. stays constant

19. Relative to the front-back position of the human body, the spinal cord runs:
    a. in front of the spinal discs
    b. through the spinal discs
    c. behind the spinal discs
    d. on top of the spinal discs

20. In the Munsell system colour circle, which of the following colour pairs are adjacent to each other:
    a. Red/Yellow
    b. Red/Green
    c. Blue/Yellow
    d. Blue/Red

21. The span of immediate (short-term) memory is approximately how many chunks?
    a. two
    b. four
    c. seven
    d. ten

22. According to Chapanis, without rehearsal items in short-term memory tend to decay (be forgotten) in approximately:
    a. 1 to 5 seconds
    b. 7 to 10 seconds
    c. 15 to 20 seconds
    d. 1 to 5 minutes

23. Which of the following is NOT part of the international word spelling alphabet that is used to reduce confusions when calling out letters e.g., when pilots talk to air traffic controllers? (Hint, the first letters of the international word spelling alphabet are alpha, bravo, charlie).
    a. India
    b. Lima
    c. Quebec
    d. Rome

24. Reaction times are generally fastest for:
    a. infants
    b. children under the age of 15
    c. people between the ages of 15 and 60
    d. people over 60

25. According to current ergonomic guidelines and standards concerning workstation design, the centre of a computer screen should be:
    a. directly ahead of the user's eyes
    b. 15 to 25 degrees above the direct ahead position
    c. 15 to 25 degrees below the direct ahead position
    d. Placed wherever the user feels is most comfortable

Section B. 8 Short Answer Questions (5 points each for 75 Points in total). ANSWER ALL FIFTEEN QUESTIONS.

Note: the following questions are worth 5 points each. In order to help you allocate your time, the distribution of those 5 points within each question is also indicated.

1. Applied Anthropometry I

Consider the design of a subway car (train) in a major city such as Toronto where there are a large number of passengers, particularly during rush hour.

A. (1 point) List two key body dimensions that would be relevant to designing the doors.

B. (1 point) List two key body dimensions that would be relevant to designing the location and shape of hand straps hanging down from the ceiling.

C. (3 points) Briefly describe a cost effective strategy for obtaining information about one of the body dimensions noted above (in part a or part b) that would be relevant to the design of the subway trains in Toronto.

2. Personality I

(5 points) The Big Five model describes human personality in terms of five factors, which can be referred to by the acronym OCEAN

List the names of the factors corresponding to the O, C, E, A, and N in OCEAN, and explain what each of them means either with a short one or two sentence description, or with a list of two or three adjectives that describe people with different levels of that factor.

3. Personality II

(5 points) Based on the brief profile below, estimate what the MBTI traits might be for Joe, Dan, and Susan as they prepare to write the final report for a design project. Beside each trait in each profile, put the number (or numbers) of the point or points below that provide evidence in support of that trait assignment. Your answer should be in the following form (but with the correct trait and evidence assignments).

Joe: I(1)N(2)T(3)J(4)
Dan: I(1)N(2)T(3)J(4)
Susan: I(1)N(2)T(3)J(4)

If you don't think that there is enough evidence to label a particular trait for a person, put an X in place of it.

1. Joe and Susan enjoy meeting regularly while Dan would prefer to work alone.

2. Joe and Susan want to wait until the preceding weekend and then work like crazy over that weekend to finish the report. They argue that this will give them plenty of

time to find out more about the project and will give them a chance to try out different possibilities for the design.

3. Dan wants to nail down the final design as soon as possible and get the report written and revised well before the deadline.

4. Joe and Dan want to spend more time thinking about design ideas, while Susan wants to run surveys and do experiments about how the design would work.

5. Susan worries that Dan doesn't enjoy being part of the team and she tries to find out why he doesn't come to meetings and what she and Joe can do about that. Joe thinks that worrying about Dan's personal concerns is just a waste of time and that everyone should just get on with the project. Dan appreciates Susan's concern and wishes that Joe would be more considerate, like Susan is.

4. Attention and bus driving

a) (1 points) Give a short one sentence definition of "attention" as the term is used in cognitive psychology.

b) (1.5 points) List three types of human attention.

c) (2.5 points) Briefly describe how the task of driving a shuttle bus around campus for an eight hour shift might create attentional problems for the driver of that bus.

5. Task Analysis and Human Requirements

a) (1 point) What is task analysis (in the context of human-centred systems design)?

b) (1 point) Name a task analysis method that can be used to help uncover human requirements for a design project

c) (2 points) Describe briefly how that task analysis method would be used to identify human requirements.

d) (1 point) Name one other method that can be used to identify human requirements (at least in some projects)

6. Data Collection

a) (1 point) What type of data collection method is most often used in measuring personality and intelligence?

b) (2 points) Name one data collection method that was used in your design project and briefly explain what information it provided and how that information was used to support the design project.

c) (2 points) Explain briefly what the benefits of using a randomized sample are (when collecting data from people).

7. Statistics and Design

a) (1 point) Name a statistical measure that is typicaliy used to estimate the variability in a statistical sample

b) (4 points) Suppose that a design team is designing a software interface and has come up with three possibilities. They carry out an experiment to see if people perform significantly better or worse on some of the interfaces. The data they have collected is for three different interfaces, with 6 observations per interface (i.e, a total of 18 people/observations in a between-subjects design). The results of the analysis that they run are presented in the table below.

Fill in the missing portions of the table below (you have been provided with sufficient information to do so) and calculate the F ratio for the Interfaces effect. **Re-write the completed table IN YOUR ANSWER BOOK.**

	SS	df	Meansquare (MS)	F(2,15)
Interfaces	100			
Error	150		10	
Total	250	17		

8. Repetitive Stress Injuries

a) (3 points) A construction site in the high arctic uses pneumatic drills (jackhammers) in cold weather. What repetitive stress injury might tend to occur in this situation and briefly explain why.

b) (2 points) List four interventions and modifications to the task that can be made to reduce the likelihood of repetitive stress injuries in general.

9. Driving

a) (1 point) How can visual acuity be measured?

b) (4 points) Should elderly drivers be tested differently in driving tests than younger drivers? Justify your answer with respect to the skills required for driving and the possible effects of aging on those skills.

10. Visual vs. Auditory Channel

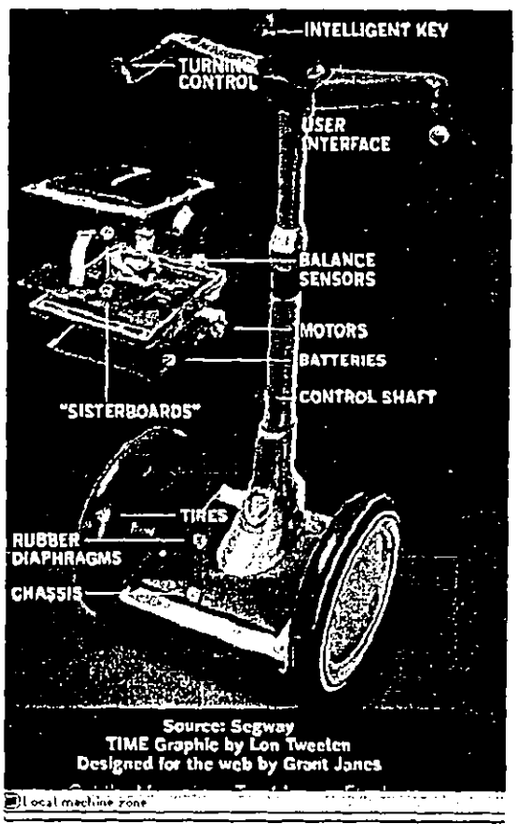
a) (2 points) List two differences in the way that information is handled by the auditory vs. the visual channel (in humans)

b) (3 points) With reference to a waking up system, briefly discuss some of the advantages and disadvantages of using light versus using sound to wake people up.

11. User-Centred Design

The picture below shows a personal transportation device that functions like an intelligent scooter. The user stands on the platform between the wheels and then leans forward. The following instructions allow most people to control the vehicle:

"Just lean forward to go forward"
"Just think about stopping to stop."
"Think about backing up to back up.
"Twist the wrist to turn"
"No matter which way you lean or how hard, the scooter won't let you fall over."
(because the machine is sensing and reacting to subtle shifts in your balance)



(5 points) Select (name) five of the principles of user-centred design listed by Donald Norman and briefly explain how well the scooter described above conforms to each of those principles.

12. Percentiles and Individual Differences

a) (2 points) Briefly explain what a percentile is as it applies to the measurement of human populations

b) (2 points). Explain briefly why individual differences in humans tend to increase with age.

c) (1 point) What is presbyopia?

13. Work Physiology and Rest periods

a) (2 points) Briefly explain why heart rate tends to increase as the amount of energy expenditure (kcal/min) increases.

b) (2 points) The number of minutes rest required for a certain amount of physical work is defined by an equation where:

minutes of rest required = T(K-S)/(K-1.5)

If the task time is 60 minutes, the work metabolic rate is 10Kcal/min, and the standard metabolic rate is 4Kcal/min, use the equation above to calculate the rest time required (show your working for full marks).

c) (1 point) Draw a simple graph roughly showing the relationship between oxygen consumption and energy expenditure in humans (hint: it should be some sort of curve or line).

14. HF in Fighter Aircraft

a) (1 point) Explain briefly why pilots tended to lose consciousness during high-G maneuvers in early jet aircraft.

b) (2 points) Give examples of two strain maneuvers

c) (1 point) Explain how strain maneuvers work to help lower the risk of gravity induced loss of consciousness

d) (1 point) How can a pressurized suit help prevent loss of consciousness under high G-loading?

15. Psychophysics

a) (2 points) Give two examples of how human senses tend to provide information about relative rather than absolute magnitudes.

b) (3 points) In the context of this course, what is a decibel and how is it calculated?