IE-341
Section 1, CRN: 30512; Section 2, CRN: 30515; Section 3, CRN: 38299
First Semester 1433-34 H (Fall-2012) – 3(2,1,2)
HUMAN FACTORS ENGINEERING

Monday, Oct 15, 2012 (29/11/1433H)

MIDTERM 1 [10 POINTS] **ANSWERS**

Name:	Student Number: 4	Section: 9:00 / 10:00 / 11:00

Place the correct LETTER in the box at the right of each question [$\frac{1}{2}$ Point Each]

1. **HF engineering concerned with human-machine interaction is called …** **D**

   A. human capabilities

   B. human sociology

   C. human psychology

   D. ergonomics (*see slide 1-2*)

   E. anthropometry

2. **What is a "hierarchical" system?** **A**

   A. it is a system consisting of several levels of subsystems (*see slide 1-10*)

   B. it is a system where the components have no relation to one another

   C. it is a system consisting of many components

   D. it is a system that serves only one objective

   E. it is a system having an immediate boundary

3. **Which of the following carries importance according to the information theory?** **E**

   A. siren (honk) in the car produces a sound every time you press it

   B. traffic signal switching from green to yellow to red

   C. a gun fires a bullet when the trigger is pulled

   D. machine "on" switch lights up when plugged to the electricity outlet

   E. machine indicating that it needs to be repaired (*see slide 3-I-3*)

4. **What is the major difference between the "Hick" and "Hick-Hyman" laws?** **B**

A. only "Hick's" law shows a linear relation

B. redundancy is higher in the "Hick-Hyman" law (*see slide 3-I-8*)

C. the number of stimuli changes in the "Hick-Hyman" law

D. redundancy is higher in "Hick's" law

E. the response time is measured only in "Hick's" law

5. **A safety sign that can be understood in little time has high …** **C**

A. Movement Compatibility

B. Spatial Compatibility

C. Conceptual Compatibility (*see slide 3-II-15*)

D. Modality Compatibility

E. General Compatibility

6. **Which of the following is an example of an alphanumeric display?** **D**

A. traffic lane

B. traffic light

C. emergency signal

D. traffic sign (*see slide 3-II-7*)

E. map

7. **What is the "elbow rest height"?** **B**

A. the distance from the underside of the foot to the elbow (while sitting)

B. the distance from the underside of the thighs to the elbow (while sitting) (*see slide 2-I-6*)

C. the distance from the underside of the foot to the elbow (while standing)

D. the distance from the underside of the knees to the elbow (while sitting)

E. the distance from the hip to the elbow (while standing)

8. **When converting static to dynamic anthropometric data …** **A**

A. stature height should be slightly decreased (*see slide 2-I-14*)

B. elbow height should be slightly decreased

C. sitting knee height should be slightly decreased

D. forward reach must be increased by 30%

E. shoulder height should be slightly increased

9. **List work tasks in descending order of recommended work-surface height:** **E**

A. heavy work; precision work; light assembly work

B. heavy work; light assembly work; precision work

C. precision work; heavy work; light assembly work

D. light assembly work; precision work; heavy work

E. precision work; light assembly work; heavy work (*see slides 2-II-12-14*)

10. **A work-surface height that is *too high* causes injury to which part of the body?** **E**

A. upper back

B. lower back

C. neck and lower back

D. shoulder and upper back

E. neck and shoulder (*see slide 2-II-9*)

11. **Which of the following is the earliest integration of HF Engineering in industry?** **B**

A. HF Engineering in office applications

B. designing workstations for the disabled (*see slide 1-6*)

C. post-World War 2 applications

D. HF Engineering in forensics

E. HF Engineering in devices for the elderly

12. **System relying mostly on physical energy to produce a desired output is a …** **D**

A. automated system

B. closed-loop system

C. mechanical system

D. manual system (*see slide 9*)

E. open-loop system

13. **The probability of *failure* for a car ignition system which is operated an average of 50 times per month, and has failed three times in one year is …** **C**

A. 99.5%

B. 5%

C. 0.5% $p_{failure} = \frac{n_{failure}}{n_{total}} = \frac{3}{50*12} = \frac{3}{600} = 0.5\%$

D. 0.005%

E. 6%

14. **What is the reliability of a system consisting of 4 components connected in *series*, having respective reliabilities of 95%, 90%, 85%, 80%?** **C**

A. 99.99%

B. 40.96%

C. 58.14% $Rel_{sys} = \prod_{i=1}^{n=4} Rel_{comp,i} = 0.95 * 0.9 * 0.85 * 0.8 = \mathbf{58.14\%}$

D. 81.45%

E. 41.86%

15. **Repeat the previous problem with the same 4 components connected in *parallel*.** **C**

A. 81.45%

B. 40.96%

C. 99.99%

$$1 - (1 - Rel_{comp,1})(1 - Rel_{comp,2})(1 - Rel_{comp,3})(1 - Rel_{comp,4})$$
$$= 1 - (0.05 * 0.1 * 0.15 * 0.2) = 1 - 0.00015 = \mathbf{99.99\%}$$

D. 58.14%

E. 41.86%

16. **How much information is involved with throwing a *ten*-sided die (see below)?** **E**

A. 5.00 Bits

B. 1024 Bits

C. 0.30 Bits

D. 1 Bit

E. 3.32 Bits $H = \log_2 N = \log_2 10 = \frac{\log 10}{\log 2} = \frac{1}{0.301} = \mathbf{3.32\ Bits}$

17. **Calculate the redundancy involved with deciding between two events where the second event is *twice* as likely to occur as the first event?** **B**

A. 91.83%

B. 8.17% $p_1 + 2p_1 = 1$

$\Rightarrow p_1 = 0.333, p_2 = 2p_1 = 0.667$

$$Red. = 1 - \frac{H_{ave}}{H_{max}} = 1 - \frac{\sum_{i=1}^{N=2} p_i \left(\log_2 \frac{1}{p_i}\right)}{\log_2 N = 2} = 1 - \frac{p_1 \left(\log_2 \frac{1}{p_1}\right) + p_2 \left(\log_2 \frac{1}{p_2}\right)}{\log_2 2}$$

$$= 1 - \frac{\frac{1}{3}(\log_2 3) + \frac{2}{3}(\log_2 1.5)}{1} = 1 - \left[\frac{1}{3}\left(\frac{\log 3}{\log 2}\right) + \frac{2}{3}\left(\frac{\log 1.5}{\log 2}\right)\right]$$

$$= 1 - [0.5283 + 0.3900] = 1 - 0.9183 = 0.0817 = \mathbf{8.17\%}$$

C. 47.17%

D. 4.09%

E. 61.01%

18. **Ali scored the 76th percentile among 400 people on the TOEFL test, where the maximum score is 700 points. Thus,**

A

A. 96 people received a better grade than Ali's

76% of people scored less than or equal to Ali $\Rightarrow \frac{76}{100} * 400 = 304\ people$

$400 - 304 =$ **96 people received a better grade than Ali**

B. 96 people received a grade equal to or worse than Ali's

C. 76 people received a better grade than Ali's

D. Ali received a grade of 168/700

E. Ali received a grade of 76/400

Questions 19-20. Examine the data below, taken from an article studying anthropometric data for 49 fire personnel in Hong Kong.

Measurments	Mean	S.D.	C.V.%	Min	Max	5%	25%	50%	75%	95%
Weight (kg)	66.2	6.1	9.21	55	80	57.7	62	65.0	71.0	77.0
Height (cm)	173.8	4.3	2.47	168	183	168.5	170	173.5	177.5	181.1
Cervicale height	143.36	3.82	2.66	137	154	138.0	140	143.0	147.0	148.6
Back waist	107.74	3.16	2.93	101	118	103.0	106	107.5	110.0	112.6
Outside leg	84.39	3.06	3.63	78	90	79.5	82	84.0	86.5	89.0

19. **The median and average statures of all workers, respectively are…**

D

A. 173.8 cm; 173.5 cm

B. 173.5 cm; 170.0 cm

C. 177.5 cm; 173.8 cm

D. 173.5 cm; 173.8 cm (note, stature = height; average = mean; 50% = median)

E. 168 cm; 183 cm

A

20. **Which of the following can be the 96th percentile weight (i.e. mass)?**

A. 77. 6 kg note,

$95\%ile: \mathbf{77.0\ kg} < 96\%ile: \mathbf{77.6\ kg} < maximum, i.e. 100th\ \%ile: \mathbf{80\ kg}$

B. 76.4 kg

C. 80 kg

D. 71.4 kg

E. 55.2 kg