UNIVERSITY OF SWAZILAND

Faculty of Health Science

Department of Environmental Health Science

Main Semester I1 Examination

May 2012

Title of paper: Acoustics and Health II

Course code: EHS 570

Time allowed: 3 HOURS

Marks allocation: 100 Marks

Instructions:

1) ANSWER **ANY FOUR QUESTIONS**
2) Question 1 is compulsory
3) Each question is weighted 25 marks
4) Write neatly and clearly
5) Formulas and other useful data have been provided with this paper

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION TO DO SO HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

QUESTION 1

I.

Multiple choice: Write True or False against each letter corresponding to the following statements as they apply to acoustics.

(a) In noise control programs, the degree of noise reduction required is determined by comparing the measured levels with acceptable noise levels.
(b) The risk of hearing loss from high noise environments depends on both the level of noise and the length of time an individual is exposed to that level.
(c) Most sound level meters provide the option of quantifying the combined sound at all frequencies.
(d) When a noise source is located in any environment, other than free field, the sound pressure level at any point in the field will depend upon the sound pressure level and Q values.
(e) The noise reduction achieved by adding sound absorption to an enclosure can be determined by comparing the sound pressure level in the enclosure after adding sound absorption to that before the absorption was added.
(f) The rate of decay of sound within a room is independent of the rate at which energy is extracted from the sound waves by the absorbent boundaries.
(g) The flat response looks at the entire audible frequency spectrum without applying any weighting.
(h) For the purpose of evaluating personnel noise exposures, the A-weighted sound level is needed at the ear of the person being monitored.
(i) In the region close to the source, the sound pressure level is independent of the room constant, R, and the sound can be reduced by adding sound absorption to the enclosure.
(j) Dosimeters can be used to identify specific noise sources.

(20 marks)

II.

Describe the purposes of a detailed noise survey.

(5 marks)

QUESTION 2

a) Describe the five (5) primary reasons for reducing noise levels in an occupational environment.

(15 marks)

b) Noise exposures must be controlled whenever they exceed government or company noise requirements. Usually the best first step to reduce noise is to develop a written noise control plan. Describe the elements of such a plan.

(10 marks)

QUESTION 3

a) Describe five (5) components of an effective Hearing Conservation Programme.

(15 marks)

b) Describe the elements of the basic plan for determining compliance with Occupational Safety and Health Administration (OSHA) noise survey.

(10 marks)

QUESTION 4

(a) A worker in an engineering workshop is exposed to the following noise levels:

88 dBA for 3hours
93 dBA for 2hours
86 dBA for 1.5hours

Determine $L_{Ep,d}$ for this individual.

(7 marks)

(b) A 1.5m x 6m door is located in a 3m x 8m wall. The door has a sound reduction index of 15dB while that of the wall is 25dB.
Determine the sound reduction index of the combination.

(6 marks)

(c) A wall 15m x 25m with an initial sound reduction index of 50dB has three (3) windows built into it. The area of each window is $5m^2$ and its sound transmission coefficient is 0.01. Determine the new sound reduction index of the wall with windows.

(6 marks)

(d) Determine the reverberant times. T, for rooms, 5m x 10m x 3.5m with the following characteristics:

i) $\alpha = 0.1$, $S = 205m^3$, $V = 175m^3$
ii) $\alpha = 0.25$, $S = 205m^3$, $V = 175\ m^3$

(6 marks)

QUESTION 5

a) A 6m x 9m x 5m room has a 10-microwatt ($1\mu W = 10\ m^6$ watts) sound source located in the centre of the 6m wall where the floor and wall meet. The absorption coefficient associated with the room are:
Wall: $\alpha = 0.02$;
Floor: $\alpha = 0.1$ and
Ceiling: $\alpha = 0.26$
Find the sound pressure level at the centre of the room, first taking into account the presence of the reverberant field and then assuming only direct sound radiation from the sound source.

(11 marks)

b) A 2.4m x 6m, 10.2cm thick brick wall has two 0.3175cm thick 0.9m x 1.5m glass windows in it.
NB: The specific surface density for the brick is $21kg/m^2/cm$ and for glass is $24.7\ kg/m^2/cm$.

i) Compute the normal incidence transmission loss for the brick wall and windows individually and at a frequency of 500Hz.

(8 marks)

ii) Compute the normal incidence transmission loss of the composite barrier composed of the brick wall and two windows.

(6 marks)