UNIVERSITY OF SWAZILAND

FACULTY OF HEALTH SCIENCES

BSc IN ENVIRONMENTAL HEALTH SCIENCE

(FINAL EXAMINATION)

TITLE OF PAPER : ACOUSTICS AND HEALTH II

COURSE CODE : EHS 570

TIME : 3HOURS

TOTAL MARKS : 100

INSTRUCTIONS:

- QUESTION 1 IS COMPULSORY
- ANSWER ANY OTHER THREE QUESTIONS
- ALL QUESTIONS ARE WORTH 25 MARKS EACH
- FORMULAE AND OTHER DATA IS PROVIDED
- NO FORM OF PAPER SHOULD BE BROUGHT IN OR OUT OF THE EXAMINATION ROOM
- BEGIN THE ANSWER TO EACH QUESTION IN A SEPARATE SHEET OF PAPER.

DO NO OPEN THIS EXAMINATION PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.

QUESTION 1

I.

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

a) If the noise level is steady throughout the exposure period, then a direct measurement of the A-weighted sound pressure level provides an adequate basis for determining exposure.
b) Where the noise level fluctuates, as it happens in most industrial situations, the concept of the equivalent continuous sound level is used.
c) The A-weighted response stimulates the sensitivity of the human ear at high sound levels.
d) The flat response looks at the entire audible frequency spectrum without applying any weighting.
e) The most significant danger from noise is its inability to damage the sense of hearing.
f) 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, that is, the A-weighted energy dose received by the ear
g) The exposure of individuals who move randomly around areas of different noise level can only be satisfactorily monitored with a personal noise dosimeter.
h) In the region close to the sound 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.
i) The reverberation time is the time taken for the intensity of a sound to be reduced to tone billionth of the level existing when the source was switched off.
j) Under certain conditions the projected wavelength of the incident sound can be in the walls. This condition is known as coincidence, and when it occurs it gives rise to a marked reduction in the effective insulation.

(20 marks)

II.

Briefly describe the dosimeter and its functions.

(5 marks)

QUESTION 2

a) The best first step to reduce noise is to develop a written noise control plan. Describe the components of such a plan.

(10 marks)

b) A 5 m x 10 m x 3m room has a 1 microwatt (1 $\mu W = 10^{-6}$ watts) sound source located in the centre of the 5 m wall where the floor and the wall meet. The absorption coefficients associated with the room are: walls $\alpha = 0.02$, 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.

(10 marks)

c) An office is separated by a partition wall of an area 100 m^2 having a sound reduction index of 40 dB. A door of area 2.5 m^2 having a sound reduction index of 30 dB is added to the partition. If the room adjoining the office has a sound pressure level of 75 dB, find the sound pressure level in the office when the door is closed.

(5 marks)

QUESTION 3

a) An employee is exposed to the following noise levels during the workday:

85 dBA for 3.75 hours
90 dBA for 2 hours
94 dBA for 2 hours
95 dBA for 0.25 hours

Calculate the daily dose and give your conclusion about the exposure.

(4 marks)

N.B The permissible noise exposures are as follows:

Duration per day	**Sound level (dBA)**
8	90
6	92
4	95
1½	102
1	105
½	110
¼	115

b) A 2.4m x 6m, 10.2cm thick brick wall has two 0.3175cm thick 0.9m x 1.5m windows in it.

NB: The specific surface density for the brick is 21kg/m^2/cm and for glass are 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.

(9 marks)

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

(8 marks)

c) What are the purposes of a detailed survey?

(4 marks)

QUESTION 4

a) Describe three (3) primary reasons for reducing noise levels in an occupational environment.

(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 5

Describe the following noise control measures as applied in Acoustics and health.

a) Administrative controls

(3 marks)

b) Engineering controls

(8 marks)

c) Reduce driving force

(5 marks)

d) Reduce response of vibrating force

5 marks)

e) Reduce radiation efficiency by reducing area of vibrating surface

(4 marks)

(25 marks)