SWAZILAND

FACULTY OF HEALTH SCIENCES

DEGREE IN ENVIRONMENTAL HEALTH SCIENCES

(FINAL EXAMINATION)

TITLE OF PAPER : **ACOUSTICS AND HEALTH II**

COURSE CODE : **EHS 570**

TIME : **2HOURS**

TOTAL MARKS : **100**

INSTRUCTIONS:

- **ANSWER ANY FOUR QUESTIONS**
- **QUESTION 1 (I) IS MULTIPLE CHOICE**
- **ALL QUESTIONS ARE WORTH 25 MARKS EACH**
- **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

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

a) The effect of noise can lead to a decrease in working efficiency and it can present a safety risk.

b) The Reverberation time (T) is the time taken for the intensity of a sound to be reduced to be one millionth of the level existing when the source was switched off.

c) The risk of hearing loss from high noise environments depends on the noise level and the length of time of exposure.

d) 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.

e) The concept of the equivalent continuous sound level is used where the noise level fluctuates, as it happens in most industrial situations.

f) The first action level may be defined as daily personal exposure of 90 dB(A)

g) The exposure of individuals who move randomly around areas of different noise level can only be satisfactorily monitored using the integrated sound level meter.

h) The direct field is due to reflections from the room surfaces and the reverberant field is due to noise radiating directly from the source.

i) Occupational noise regulations require that whenever employees are exposed to excessive noise levels, feasible administrative or engineering controls should be used to reduce those levels.

j) A partition between two rooms can well be designed acoustically, but its performance can be markedly reduced by leakage through imperfections in assembly or by the sound travelling round the partition.

(20 marks)

II.

Determine the LEP, d for a worker having the following exposure pattern.

87dB (A)	for 2 hours
89 dB (A)	for 3 hours
92 dB (A)	for 1.5 hours

(5 marks)

QUESTION 2

i) A 5 m x 10 m x 3.5 m room has a 10-microwatt (1 μW= 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 α = 0.02, floor α = 0.1 and ceiling α = 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.

(14 marks)

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

N.B The specific surface density for brick is 21 kg/m^2/cm and for glass is 24.7 kg/m^2/cm.

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

(6 marks)

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

(5 marks)

QUESTION 3

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

88 dB (A) for 4 hours
93 dB (A) for 1 hour
86 dB (A) for 3 hours

Determine the $L_{EP,d}$ for this individual.

(6 marks)

b) What are the purposes of a detailed noise programme

(4 marks)

c) Describe the essential requirements of the Noise at work Regulations.

(12 marks)

QUESTION 4

Describe the components of a noise control programme.

(25 marks)

QUESTION 5

(a) A 6 m x 8 m x 4 m room has a 10-microwatt (1 $\mu W = 10^{-6}$ watts) sound source located in the centre of the 6 m wall where the floor and the wall meet. (See figure 1). The absorption coefficients associated with the room are: walls α = 0.02, floor α = 0.1 and ceiling α = 0.26.

(i) 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.

(13 marks)

b) Determine the reverberant times, T, for rooms 5m x 10m x 3.5m with The following characteristics:

(i) $\alpha = 0.1$, $s = 205m^2$, $v = 175\ m^3$
(ii) $\alpha = 0.25$, $s = 205m^2$, $v = 175m^3$

(4 marks)

c) i) A 1 m x 5 m door is located in a 4 m x 7 m wall. The door has a sound reduction index of 20 dB while that of the wall is 30 dB. Determine the sound reduction index of the combination

(4 marks)

ii) An office is separated by a partition of 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 power level in the office when the door is closed.

(4 marks)