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UNIVERSITY OF SWAZILAND
FACULTY OF HEALTH SCIENCES
DEGREE IN ENVIRONMENTAL HEALTH SCIENCES
(FINAL EXAMINATION)

TITLE OF PAPER : ACOUSTICS AND HEALTH II
COURSE CODE : EHS 570
TIME : 3HOURS
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.

I.

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

- a) In the region close to a noise source, the direct field will dominate and the sound power level is independent of the room constant, R.
- b) In the region in which the direct field dominates adding sound absorption to the enclosure can reduce sound.
- c) In the region remote from the noise source, the reverberant field dominates and changing the room constant, R can change the sound power level.
- d) According to the Noise at Work Regulation (British) the first action level is defined as the daily personal noise exposure of 90B (A).
- e) The Noise Reduction Coefficient (NRC) is the arithmetic average of absorption coefficients in the four octave bands between 250 Hz and 2000Hz.
- f) The free field environment is necessary in obtaining accurate determination of the sound pressure level and directivity characteristics of a source.
- g) 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.
- h) Sound with a frequency below 20Hz is called ultrasound and sound with a frequency above 20 000Hz is called infrasound.

- 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 traveling round the partition.

(20 marks)

II.

What is the sound pressure level in the room in Question 3 (a) below, if the absorption coefficient (α) for the ceiling is 0.7?

(5 marks)

QUESTION 2

- (a) 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

(7 marks)

- (b) Describe how noise is measured

(14 marks)

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

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

(4marks)

QUESTION 3.

- (a) A 6 m x 8 m x 4 m room has a 10-microwatt ($1 \mu\text{W} = 10^{-6}$ 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 $\alpha = 0.02$, floor $\alpha = 0.1$ and ceiling $\alpha = 0.26$.

- (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.

(11 marks)

- (b) 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 $21 \text{ kg/m}^2/\text{cm}$ and for glass is $24.7 \text{ kg/m}^2/\text{cm}$.

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

(8 marks)

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

(6 marks)

QUESTION 4

Describe the components of a noise control programme.

(25 marks)

QUESTION 5

- a) What are the purposes of a detailed noise survey?

(5 marks)

- b) Describe the risk factors of hearing loss.

(20 marks)