UNIVERSITY OF SWAZILAND

FACULTY OF HEALTH SCIENCES
DEPARTMENT OF ENVIRONMENTAL HEALTH
BSc DEGREE IN ENVIRONMENTAL HEALTH SCIENCES
RESIT EXAMINATION, 2021

TITLE OF PAPER : **ACOUSTICS AND HEALTH**

COURSE CODE : **EHS 401**

TIME : **2HOURS**

TOTAL MARKS : **100**

INSTRUCTIONS:

- **QUESTION 1 IS COMPULSORY**
- **ANSWER ANY OTHER THREE QUESTIONS**
- **ALL QUESTIONS ARE WORTH 25 MARKS EACH**
- **FORMULAE AND PERIODIC TABLE ARE PROVIDED**
- **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.

c) Two sound sources are radiating sound waves of different frequencies and the individual sound pressure levels recorded are 75 and 80dB. Determine the total sound pressure level.

(8 marks)

QUESTION 3

a) The background sound pressure level at a point is 65dB. Sound from a fan increases this to 78dB. What would be the sound pressure level due to the fan alone?

(8 marks)

b) The 1/1 octave band sound pressure levels of the noise from a garbage disposal are given below. Determine the overall noise level of the garbage disposal.

Freuency	Hz	63	125	250	500	1000	2000	4000	8000
Sound Pressure level	dB	64	85	70	60	56	53	53	50

(10marks)

c) Describe how noise problems can be identified at the workplace.

(7 marks)

QUESTION 4

a) A simple spherical sound source radiates sound into whole space with 1acoustic watts of power at frequency of 600 Hz. Find the acoustic intensity and sound pressure at radial distances of 1m and 2m from the source.

(12 marks)

b) Two sound sources are radiating sound waves of different frequencies and the individual sound pressure levels recorded are 88 and 85dB. Determine the total sound pressure level.

(5 marks)

c) The background sound pressure level at a point is 75 dB. Sound from a fan increases this to 78 dB. What would be the sound pressure level due to the fan alone?

(8 marks)

QUESTION 5

a) The sound pressures of the sound propagating in a duct were measured in the indicated areas and were found to be:
$P_{rms}(1) = 3.2 \times 10^{-2}$ Pa $P_{rms}(2) = 4.0 \times 10^{-2}$ Pa

$P_{rms}(3) = 2.52 \times 10$ -2 Pa $P_{rms}(4) = 2.82 \times 10^{-2}$ Pa

The dimensions of areas 1, 2, 3 and 4 of the duct are 0.5m x 0.5m each.

1	2
3	4

Determine the acoustic sound power of the sound that is propagating in the duct.

N.B: $W = \sum_{I=1}^{4} \frac{p^{2rms(1)} S_i}{\rho C}$, where $\rho C = 420$ RAYLS.

(5 marks)

b) A simple spherical sound source radiates sound into whole space with 10 acoustic watts of power at frequency of 700 Hz. Find the acoustic intensity and sound pressure at radial distances of 1m and 2m from the source.

(8 marks)

c) If a pure tone acoustic wave has a S.I.L of 95dB what is the peak value of acoustic pressure?

(6 marks)

d) A hydraulic pump driven by a 2kW electric motor has a sound power level of 90 dB.

What percentage of the electrical energy consumed by the pump is emitted as noise?

(6 marks)

FORMULAE- ACOUSTIC AND HEALTH/RADIOACTIVITY AND RADIATION

1. $W = \sum_{i=1}^{4} \frac{\text{p rms(I)S}}{\rho C}$ where ρC = 420 RAYLS
2. $SPL = 10 \log (p_1/p_0)^2$
3. $NR = 10 \log_{10} = \frac{TA_2}{TA_1}$
4. $SPL_t = 10 \log_{10} [\Sigma 10^{SPL/10}]$
5. $SWL = 10 \log W/W_0$
6. $I = \frac{W}{A}$
7. $I = \frac{p^2_{rms}}{\rho C}$ or $p_{rms} = (I \rho C)^{1/2}$
8. $S.I.L = 10 \log_{10} (I/I_{ref})$
9. $R = \frac{S\bar{\alpha}}{1-\bar{\alpha}}$
10. $\bar{\alpha} = \frac{S_i\bar{\alpha}_i + S_2\,\bar{\alpha}_2 + \ldots}{S_i + S_2}$
11. $SPL_t = SWL + 10 \log_{10} \{ \frac{Q}{4\pi r^2} + \frac{4}{R} \}$
12. $T = \frac{0.161\,V}{S\bar{\alpha}}$
13. $T = \frac{0.161\,V}{-S[\ln(1-\bar{\alpha})] + 4mV}$
14. $\tau = \frac{p_t^2/\rho C^2}{p_i^2/\rho C^2}$
15. $TL = 10 \log_{10} [\frac{1}{\tau}]$
16. $t = \frac{1}{1.21 \times 10^{-4}\ yr^{-1}} \ln(\frac{0.227}{s})$
17. Radiation Intensity $\propto \frac{1}{d^2}$