UNIVERSITY OF SWAZILAND

FACULTY OF HEALTH SCIENCES
DEPARTMENT OF ENVIRONMENTAL HEALTH
BSc DEGREE IN ENVIRONMENTAL HEALTH SCIENCES
SUPPLEMENTARY EXAMINATION, JULY, 2018

TITLE OF PAPER : **ACOUSTICS AND HEALTH**

COURSE CODE : **EHM 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.

QUESTION 1

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

a) A personal hearing protector can be worn to cover the ears and ear canal entrance or inserted in the in the ears of a person to protect his hearing.

b) Where plant is designed for a particular workplace, designers should design plant to eliminateor control noise emissions where there is a risk to a person's hearing.

c) In the hierarchy of noise control measures, administrative controls are the highest in terms of implementation of controls.

d) Noise assessment records should be kept at the workplace and made available for inspection by management.

e) Areas where people may be exposed to excessive noise should be signposted as "hearing protection areas" at every entry point to areas and their boundaries should be clearly defined.

f) The Integrated Sound Level Meter cannot be used to measure equivalent noise level averaged over the measurement period,

g) In regions closer to the noise source, the reverberant field will dominate,

h) Sound is a disturbance or wave which moves through a physical medium from a source to cause the sensation of hearing in people and animals.

i) The pressure changes produced by a sound wave are known as the sound power.

j) Wave velocity is the speed with which sound travels through the medium.

k) A source that emits power equally in all directions is called an omnidirectional source.

l) As the distance from the source increases, the sound intensity increases according to the inverse square law

(24 marks)

II,
What is a sound with a frequency below 20 Hertz called?

(1 marks)

QUESTION 2

a) Describe frequency analysis

(5 marks)

b) Describe the components of and taking measurements using a Sound Level Meter.

(12 marks)

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) State nine (9) aims of a noise risk assessment

(9 marks)

c) Describe the four (4) primary reasons for reducing noise levels in an occupational environment.

(8 marks)

QUESTION 4

a) An office is separated by a partition wall 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 sound pressure level of 75 dB, find the sound pressure level in the office when the door is closed and when it is open

(9 marks)

b) Sound waves of sound power level 70 dB are incident on a concrete wall. Assuming 1/10000 of the incident energy is transmitted through the wall, Find the sound reduction index of the wall and the reduced sound power level.

(4 marks)

c) A 2.4m x 6m, 10.2cm thick brick wall has one 0.3175cm thick 0.9m x 1.5m window 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.

(8 marks)

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

(4 marks)

QUESTION 5

a) A 1.5m x 6m door is located in a 4m x 6m wall. The door has a sound reduction index of 10dB while that of the wall is 15dB.Determine the sound reduction index of the combination.

(7 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.

(5 marks)

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

84 dBA for 2 hours
87 dBA for 3 hours
90dBA for 0.5hours

Determine the daily personal exposure ($L_{Ep,d}$) for this individual.

(7 marks)

d) Describe the main elements of the Noise at Work Regulations.

(6 marks

FORMULAE- ACOUSTIC AND HEALTH/RADIOACTIVITY AND RADIATION

1. $W = \sum_{i=1}^{4} \frac{p\,rms(I)S}{\rho C}$ where $\rho C = 420$ 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. $t = \frac{1}{1.21\,x\,10^{-4}\,yr^{-1}} \ln(\frac{0.227}{s})$
17. Radiation Intensity $\propto \frac{1}{d^2}$