First Semester Examination
Academic Session 2021/2022

February/March 2022

EAP583 – Air and Noise Pollution Control

Duration : 2 hours

Please ensure that this examination paper contains **SEVEN (7)** printed pages before you begin the examination.

Instructions: This paper contains **FIVE (5)** questions. Answer **FOUR** questions.

All questions **MUST BE** answered on a new page.

(1). Describe the use of Ringelmann Chart in Air Pollution Monitoring and Assessment.

[25 marks]

(2). (a). Transport and dispersion of air pollution is affected by atmospheric stability. Explain the categories of atmospheric stabilities and how they affect vertical movements of air parcel in the atmosphere based on the stability categories.

[9 marks]

(b). Plume was released from a 120 m stack of a factory at Perai Industrial Area. Given that:

Source characteristics	Environmental Conditions
Internal radius of stack = 5.5 m **Exit speed** = 20 ms^{-1} **Exit temperature** = 80 ^oC **Coal burn rate** = 3500 tonne/day **Sulphur content** = (use the last two digits of your matrix number, and make it up to 1 decimal place) e.g. P-WM00**09** – take 09 and make it become 0.9%; P-WM00**21**, take 21 and make it become 2.1%)	**Wind speed at 10m** = 5.0 ms^{-1} **Air temperature at stack height** = 30 ^oC

Calculate the maximum concentration of SO_2 released from the stack during cloudy weather for receptor located at 5000 m downwind of the source and at ground level on rough terrain.

[11 marks]

(c). If the stack height in question (b) is raised by 10 m, calculate the maximum concentration of SO_2 at the same receptor location and similar source characteristics and environmental conditions. Discuss your answer in comparison with answer in question (b).

[5 marks]

(3). (a). Explain **FOUR (4)** components in vehicle air pollution control strategy.

[12 marks]

(b). Noise has catastrophic physiological and psychological impacts on not only humans, but also on other organisms such as animals and plants. Explain **ONE (1)** source of noise together with its type of sound and a relevant regulation to the source of noise. Discuss **THREE (3)** effects of the chosen source of noise to receivers.

[13 marks]

(4). (a). By taking into consideration of the sound movement at different temperatures, discuss the reason a jet fighter can be noticed at a higher altitude ahead of the sound which is heard after the jet had passed.

[7 marks]

(b). Prove that a radiating area influences the sound intensity level. Use an appropriate example of any noise source.

[8 marks]

(c). Illustrate with a sketch the effectiveness of noise control by a vertical wall in reducing low-frequency noise.

[5 marks]

(d). A composite level from two noise sources tested in a control room is 71.5 dB (A). If the first level is 70 dB (A), by using **Figure 1**, estimate the other noise level if it is lower than the first level.

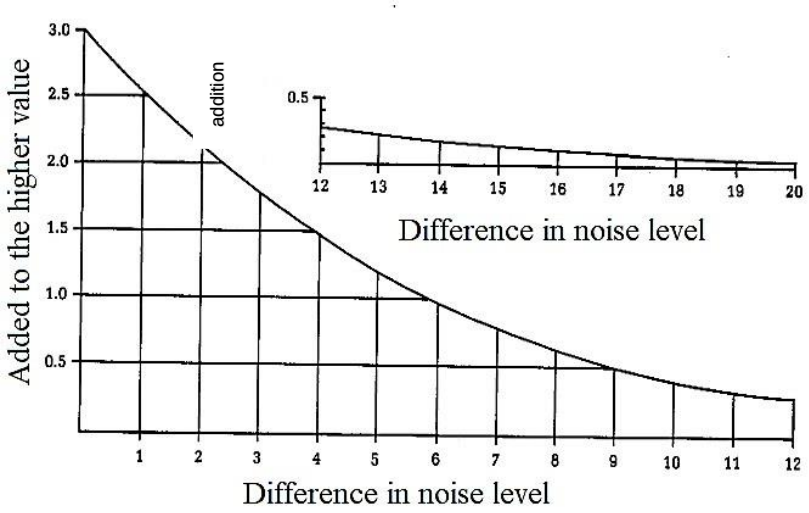

Figure 1: Summation of the noise level

[5 marks]

(5). (a). Calculate L_{Aeq} and TNI for the following noise data in **Table 2** at a construction site next to a school building (create the data for time 30 to 100 minutes and it must be in two digits):

Table 2

Time (minutes)	Noise level, dB(A)
10	81
20	70
30	--
40	--
50	--
60	--
70	--
80	--
90	--
100	--

Comment your answer with relevant noise guidelines.

[13 marks]

(b) A masonry wall with _ _ m (use the last 2 digits of your matrix number to fill in the blank. e.g. P-WM00**09** – take 0 9 m, P-WM00**21**, take 2 1 m) length and 3 m height has a transmission loss of 20 dB (A). Calculate the overall transmission loss for 135 Hz if the wall contains a glass panel with an area of 5 m^2 that has a transmission loss of 5 dB (A).

[5 marks]

(c) Determine the new transmission loss of the overall structure in (b) if a window is installed on the wall with 1 m length and 1 m height and the transmission loss of the window is 5 dB (A).

[5 marks]

(d) If the initial noise level in (c) is 70 dB (A), determine the noise level that a person living next door to the wall will hear.

[2 marks]

APPENDIX

Useful formulae:

$°K = 275 + 10°C$

$C = 20.05T^{1/2}$

$I = w/s$

$L_I = 10 \log_{10} I/10^{-12}$

$Lp = 20 \log_{10} (P/Po)$, $Po = 20\ \mu Pa$

Weighted $Lp = 10 \log_{10} (P/Po)$, $Po = 20\ \mu Pa$

$Lw = 10 \log_{10} (w/10^{-12})$

$Leq = 10 \log_{10} \sum ti\ 10^{Li/10}$

$L_{wp} = 10 \log_{10} 1/N \sum 10^{(Lj/10)}$

$L_{pp} = 20 \log_{10} 1/N \sum 10^{(Lj/20)}$

$$T_L = 10 \log_{10} \left\{ \frac{s}{\tau 1 s1 + \ldots. + \tau 2 s2} \right\}$$

$T_L = 10 \log_{10} 1/\tau$

NNI = Average Peak Noise Level + $15 \log_{10} N$ - 80
Average Peak Noise Level = $10 \log 10\ 1/N \sum 10^{\text{Peak noise level }/10}$ dB (A)

Traffic $Leq = 42.3 + 10.2 \log (Vc + 6\ Vt) – 13.9 \log D + 0.13\ S$

Traffic $Ldn = 31.0 + 10.2 \log [AADT+ T\%\ AADT/20)] -13.9 \log D + 0.13\ S$

$L_{NP} = Leq + (L_{10}-L_{90})$

$TNI = 4\ (L_{10}-L_{50}) + L_{90}\ -30$

Table 1 Meteorological conditions defining Pasquill stability categories

Wind at 10 m (m/s)	Day			Night	
	Incoming solar radiation			Cloud cover	
	Strong	Moderate	Slight	Thinly overcast or ≥4/8 clouds	Mostly clear or ≤3/8 clouds
< 2	A	A - B	B	G	G
2 – 3	A - B	B	C	E	F
3 – 5	B	B - C	C	D	E
5 – 6	C	C - D	D	D	D
> 6	C	D	D	D	D

1-A: extremely unstable
2-B: moderate unstable
3-C: Slightly unstable
4-D: neutral
5-E: slightly stable
6-F: moderate stable
7-G: extremely stable, *used for radioactive sources only*

Table 2 Power-law exponents (p) for six atmospheric stability categories

Stability Class	**Urban (rough terrain)**	**Rural (smooth terrain)**
A	0.15	0.07
B	0.15	0.07
C	0.20	0.10
D	0.25	0.15
E	0.30	0.35
F	0.30	0.55

Table 3 Formulas Recommended by Briggs ($10^2 < x < 10^4$ m) – Urban Area

Pasquill Type	**σ_y (m)**	**σ_z (m)**
A-B	$0.32x\ (1+0.0004x)^{-1/2}$	$0.24x\ (1+0.001x)^{-1/2}$
C	$0.22x\ (1+0.0004x)^{-1/2}$	$0.20x$
D	$0.16x\ (1+0.0004x)^{-1/2}$	$0.014x\ (1+0.0003x)^{-1/2}$
E-F	$0.11x\ (1+0.0004x)^{-1/2}$	$0.08x\ (1+0.00015x)^{-1}$

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