First Semester Examination
Academic Session 2019/2020

December 2019/January 2020

EAP583 – Air and Noise Pollution Control

Duration : 2 hours

Please check that this examination paper consists of **SEVEN (7)** pages of printed material including appendix before you begin the examination.

Instructions : This paper contains **FIVE (5)** questions. Answer **FOUR (4)** questions

All questions must be answered in English.

Each question **MUST BE** answered on a new page.

(1). (a). Describe the issue and challenges in implementing generic Air Quality Management.

[15 marks]

(b). Explain the vehicle emission control strategies to reduce the emission in urban areas.

[10 marks]

(2). (a). Temperature inversion is a condition when air temperature increases with height. Explain how temperature inversion can cause significant ground level air pollution.

[4 marks]

(b). Plume was released from a 125 m stack of textile industry during sunny day of 22nd June 2019 at Perai Industrial area. Given that:

Source characteristics		**Environmental Conditions**	
Internal radius of stack	= 4.5 m	Wind speed at 10 m	= 5.5 ms^{-1}
Exit speed	= 20 ms^{-1}	Air temperature at stack height	= 30 ^oC
Exit temperature	= 80 ^oC		
Coal burn rate	=3500 tonne/day		
Sulphur content	= 1.5 %		

For a receptor located at 5000 m downwind from the source, at the ground level of rough terrain, calculate the maximum concentration of SO_2 released from the stack.

[12 marks]

(c). There are three basic mechanisms which govern the control of particulate emission through collection in both fabric filters and wet collectors. With the aid of sketches, explain these **THREE (3)** basic mechanisms.

[9 marks]

(3). (a). Briefly discuss 40CFR53USEPA in the measurement of particulate air pollutants and give a suitable example for each category.

[12 marks]

(b). Noise causes devastating physiological and psychological effects not just to human being but also other creatures including animals and plants. Discuss **THREE (3)** effects of noise.

[6 marks]

(c). The problems arising from sound propagation may range from relatively simple to very complex, depending upon the nature of the source and distribution of the affected surrounding areas. List **TWO (2)** types of sound propagation and discuss **THREE (3)** factors that influence one type of the sound propagation.

[7 marks]

(4). (a). By taking into consideration of the sound movement at different temperatures, discuss why the sound of a jet fighter at higher altitute (below 0°C) is heard behind the jet.

[10 marks]

(b). Write the threshold of hearing in terms of frequency. Distinguish its relationship with wavelength and speed of sound.

[4 marks]

(c). There are many noise analysis methods done for a specific purpose. Illustrate the principle and applications of an A-weighted sound pressure level.

[5 marks]

(d). Calculate the composite Sound Pressure Level for the following data in dB: 90, 75, 60.

[6 marks]

(5). (a) The traffic noise prediction models are required as aids in the design of highways or roads and sometimes in the assessment of existing or envisaged changes in traffic noise conditions. Butterwoth - Taiping road is estimated to be occupied by the following traffic information:

Total volume of vehicles = 600 veh/hour
Volume of cars per hour = 70% of the total volume of vehicles
Percentage of trucks (six or more tires) = 15% of the total vehicles
Average speed of traffic flow during one-hour monitoring = 70 km/hr
Annual Average Daily Traffic = 20,000 veh/day

Predict the L_{eq} and L_{dn} in dB(A) at the nearest residential area with a distance of 10 m from the road.

[8 marks]

(b) Calculate Traffic Noise Index (TNI) from the following noise monitoring data:

Time (second)	Sound Pressure Level (dB(A))
10	70
20	50
30	65
40	60
50	55
60	65
70	60
80	55
90	70
100	50
110	80
120	82
130	78
140	87
150	92
160	95
170	98
180	82
190	88
200	75

[8 marks]

(c) Discuss **THREE (3)** methods of noise control and give **ONE (1)** example for each of the method.

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

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

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

...7/-

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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