# UNIVERSITI SAINS MALAYSIA

First Semester Examination
2012/2013 Academic Session

January 2013

## EAP 583/4 – Air and Noise Pollution Control

Duration : 3 hours

Please check that this examination paper consists of **SEVEN (7)** pages of printed material including 2 appendices before you begin the examination.

**Instructions** : This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions.

All questions must be answered in English.

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

1. (a) Briefly define the *Root Mean Square* principle in noise measurement.

[5 marks]

(b) A wavelength generated from a helicopter is 0.5 m at atmospheric pressure 101.325 kPa and a temperature of 5°C. Calculate the sound frequency in Hz.

[5 marks]

(c) Averaged out the Sound Pressure Level from the following field data, 90 dB, 85 dB, 76 dB, and 58 dB using formula.

[4 marks]

(d) A sound source has a sound power of 0.01 watt at 8 m distance. Compute the Sound Intensity Level in dB.

[6 marks]

2. (a) Briefly explain the following terminologies in the context of noise and pollution control course.

i. Daily Noise Dose,

ii. Noise Number Index,

iii. Illustrate different types of sound reflection and solid obstacles.

iv. Community Response to Noise

[10 marks]

(b) A sound level meter installs in the main gate of the USM -Engineering Campus for recording noise level of the vehicles passing through the road during December 20, 2011. The ten (10) minutes interval data recorded with noise level and presenting as follow:

| Time (minutes) | Lp, dB (A) |
|---|---|
| 10 | 84 |
| 20 | 92 |
| 30 | 78 |
| 40 | 83 |
| 50 | 90 |
| 60 | 84 |
| 70 | 77 |
| 80 | 78 |
| 90 | 82 |
| 100 | 90 |
| 110 | 87 |
| 120 | 94 |
| 130 | 82 |
| 140 | 76 |

Determine the $L_{eq\ (1hr)}$, $L_{dn}$, $L_{night}$ from the following given data set. Comments on your answer.

[10 marks]

3. (a) Sound engineers normally prefer A-weighted networking for reducing noise in normal work places. Octave filter are use to reduce noise in sound spectrum due to sophisticated operations. Mobile company's use 1/1 octave filter which is currently back dated technology. Therefore, it replaced with 1/3 octave filters.

   i. Describe the components of a sound level.
   ii. Compare A-weighted network and Octave filter for noise analysis.
   iii. Differentiate with example 1/1 octave and 1/3 octave filters

[12 marks]

(b) The wall in a room is made of bricks with area of 150 $m^2$. Measurement has indicated that it is capable to reduce 50 dB (A) noise level. A new 15 $m^2$ windows and 8 $m^2$ doors are planned to be installed at the wall with capacity of 25 dB (A) noise reduction Calculate the new noise reduction of this structure.

[8 marks]

4. Discuss the shift of focus in air pollution management due to the changing paradigm of pollutant emissions.

[20 marks]

5. (a) Monitoring and modeling of air pollution is important. Explain how monitoring and modeling can help in improving air quality in Malaysia.

[3 marks]

(b) With the aid a of a sketch, explain the occurrence of inversion.

[5 marks]

(c) Sulphur dioxide ($SO_2$) was emitted from a stack of coal fired power station (stack height = 115m). The coal burning rate is 6000 tonne/day and sulfur content is 1.6%. Windspeed at 10 m height is 11.2 $ms^{-1}$.

i. Calculate $SO_2$ concentration (in $\mu gm^{-3}$) at ground level, 5 kilometer downwind during cloudy weather condition. The effective release height is 214 m and p value for smooth terrain is 0.15.

[5 marks]

ii. If the stack height is reduced to 50m, calculate the ground level concentration of $SO_2$ at 5 kilometer downwind. Given that plume rise is 114 m.

[5 marks]

iii. Give the effect of stack height on dispersion as in c(i) and c(ii) on $SO_2$ concentration.

[2 marks]

6. (a) Briefly explain the difference of adsorption and absorption in the context of air pollution control.

[6 marks]

(b) The physical and chemical characteristics of the exhaust gas stream play an important role in both the selection and proper operation of an absorption system. Explain **THREE (3)** factors affecting the absorption performance.

[9 marks]

(c) Briefly discuss about gravitational settling as one of the post treatment methods for control of $PM_{10}$ and give **THREE (3)** examples of gravity settlers.

[5 marks]

**APPENDIX A**

| **Formulas Recommended by Briggs ($10^2 < x < 10^4$ m) – Open Country Conditions.** | | |
|---|---|---|
| **Pasquill Type** | **$\sigma_y$ (m)** | **$\sigma_z$ (m)** |
| A | $0.22 \times (1+0.0001x)^{-1/2}$ | $0.20 x$ |
| B | $0.16 \times (1+0.0001x)^{-1/2}$ | 0.12 |
| C | $0.11 \times (1+0.0001x)^{-1/2}$ | $0.08 \times (1+0.0002x)^{-1/2}$ |
| D | $0.08 \times (1+0.0001x)^{-1/2}$ | $0.06 \times (1+0.0015x)^{-1/2}$ |
| E | $0.06 \times (1+0.0001x)^{-1/2}$ | $0.03 \times (1+0.0003x)^{-1}$ |
| F | $0.04 \times (1+0.0001x)^{-1/2}$ | $0.016 \times (1+0.0003x)^{-1}$ |

**APPENDIX B**

Useful formulae:

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

$K = C + 273.15$

$I = w/s$

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

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

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

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

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

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

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