TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
BSc. Mechanical Engineering
EMG 2520 : Industrial & Environmental Noise Control (Paper 2)
SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: SEPTEMBER 2018
TIME: 2 HOURS
DATE: Pick Date **Sep 2018**

Instruction to Candidates:
You should have the following for this examination
- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt question **ONE** and any other **TWO** questions.
Maximum marks for each part of a question are as shown.
Do not write on the question paper.

Question ONE

a) In a 200-meter track event, the starter is located a distance of 150 m from the timers. If the air temperature is 22 ºC, how long does it take the sound of the starter's gun to reach the timers? The gas constant for air is 287 J/kg-K and the specific heat ratio $\gamma = 1.4$.　　　　(6 marks)

b) The wavelength of a sound wave is 305 mm. Determine the frequency and wave number for a plane sound wave propagated in
　　i.　Air at 20 ºC, $R = 287$ J/kg-K, $\gamma = 1.4$ and
　　ii.　Helium at 20 ºC, $R = 2078$ J/kg-K, $\gamma = 1.667$.

(10 marks)

c) A boiler feed water pump radiates sound as a spherical source. The acoustic power level for the pump is 103 dB, and the frequency of the sound wave is 63 Hz. The sound travels through air at 36.8 ºC and 101.3 kPa. At a distance of 1.50 m from the pump, determine
　　i.　the intensity and intensity level and
　　ii.　the energy density and energy density level for the sound.

(14 marks)

Question TWO

A machine produces the sound pressure level spectrum in octave bands at a distance of 3 m, as given in the table below.

	Octave band center frequency, Hz							
	63	125	250	500	1000	2000	4000	8000
L_p(OB), dB	102	96	89	83	80	79	79	77
CFA, dB	-26.2	-16.1	-8.9	-3.2	0.0	+1.2	+1.0	+1.1

Determine,
a) the overall sound pressure level and   (12 marks)
b) the A-weighted sound level at 3 m from the machine.   (8 marks)

Question THREE

a) Determine the error in the intensity meter reading if the microphone spacing is 6 mm. The frequency of the sound wave is 12 kHz, and the speed of sound in the air around the microphone is 346 m/s.   (6 marks)
b) A reverberant room has dimensions of 6 m by 10 m by 4 m high. The measured reverberation time for the room is 3.5 seconds. The air in the room is at 300 K and 101.3 kPa, at which condition the speed of sound is 347.2 m/s. The measured sound pressure level in the 500 Hz octave band due to the noise from pump in the room is 65 dB.
   i.   Determine the sound power level for the pump in the 500 Hz octave band.   (10 marks)
   ii.   The minimum distance of the microphone for the sound measuring device from the surface of the pump.   (4 marks)

Question FOUR

a) An employee works 1 hour where the sound level is 90 dBA. The worker inspects gauges and other items for 2 hours where the sound level is 92 dBA. A total of 3 hours is spent in an area around a compressor where the sound level is 94 dBA. The remaining 2 hours are spent in a relatively quiet office area where the sound level is 60 dBA. Is this employee's noise exposure in violation of the OSHA regulations?   (6 marks)
b) The hourly equivalent sound levels measured outdoors at a particular location are given in the Table below. Determine the day–night level for this data.   (14 marks)

Daytime				Night time	
Time[a]	L_A, dBA	Time[a]	L_A, dBA	Time[a]	L_A, dBA
7:00 am	50	3:00 pm	60	10:00 pm	40
8:00 am	60	4:00 pm	60	11:00 pm	40
9:00 am	70	5:00 pm	70	12:00 M/N	40
10:00 am	60	6:00 pm	60	1:00 am	30
11:00 am	60	7:00 pm	60	2:00 am	30
12:00 noon	60	8:00 pm	60	3:00 am	30
1:00 pm	60	9:00 pm	60	4:00 am	30
2:00 pm	60			5:00 am	30
				6:00 am	40
a"Time" refers to the hour beginning with the time given in table					

Question FIVE

a) Differentiate between:

    i.   Perceived Noise Level (PNL) and Equivalent Sound Level.

    ii.   Temporary Threshold Shift (TTS) and Noise-Induced Permanent Threshold Shift (NIPTS).   (8 marks)

In one area of an industrial plant, the octave band sound pressure level spectrum is given in the table below;

Octave band center frequency, Hz								
	63	125	250	500	1000	2000	4000	8000
L_p(OB), dB	59	65	70	73	69	65	59	50

Determine the maximum distance between the speaker and listener (both female) for communication in

    i.   Normal voice ($K = 50$ dB).

    ii.   Raised voice ($K = 56$ dB), and

    iii.   Loud voice ($K = 62$ dB).

          (12 marks)