Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2014 SESSION

SUBJECT CODE	:	FCB 40102
SUBJECT TITLE	:	INDOOR AIR QUALITY
LEVEL	:	BACHELOR
TIME / DURATION	:	9.00 am - 11.00 am (2 HOURS)
DATE	:	28 MAY 2014

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. Please write your answers on the answer booklet provided.
3. Answer should be written in blue or black ink except for sketching, graphic and illustration.
4. Drawing need to be returned with the answer booklet.
5. This question paper consists of ONE (1) section only. Answer ALL questions.
6. Answer all questions in English.

THERE ARE 5 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

Appendix 1 shows the floor layout of a laboratory. The ceiling height is 12 ft. Each door dimension is 4 ft x 7 ft.

(a) Propose the ISO Class specification for bilik sterility, makmal enzim bio-teknologi, makmal limnologi, makmal phycologi, makmal pemakanan dan makmal tisu kultur.

(6 Marks)

(b) Based on your answer above, calculate the maximum concentrations limits (particles/m^3 of air) for particles sizes equal to and larger than 0.3 micron and 0.5 micron.

(6 Marks)

(c) Propose the required airflow and relative room pressure for makmal tisu kultur and makmal limnologi. Based on your calculation, state the air change per hour and air velocity in each room.

(8 Marks)

Question 2

(a) Based on your answer in Question 1, determine whether the cascades pressure is guaranteed to each door opening for makmal tisu kultur and corridor area? (Assume room temperature is 15°C)

(10 Marks)

(b) Based on your answer in Question 1, sketch the air distribution system for bilik sterility, makmal enzim bio-teknologi, makmal limnologi, makmal phycologi, makmal pemakanan dan makmal tisu kultur. Show the amount of air for every supply air diffuser, return air grille and exhaust air grille (if any) in your sketch.

(10 Marks)

Question 3

(a) Based on your answer in Question 1 and 2, explain and sketch your monitoring system or devices for the room pressure in makmal tisu kultur.

(7 Marks)

(b) Based on your answer in Question 1 and 2, estimate the leakage rate from makmal tisu kultur when the door to corridor area is opened.

(7 Marks)

(c) What are the conditions or specification that you would propose, in order to maintain the pressure in makmal tisu kultur?

(6 Marks)

Question 4

There is a requirement to maintain the indoor climate, viz indoor dry bulb temperature and relative humidity at 21±1 °C and 50±5 % respectively, in makmal tisu kultur.

(a) Sketch your control mechanism in order to maintain the indoor climate as mentioned above.

(6 Marks)

(b) Explain the working principle of your control mechanism above.

(6 Marks)

(c) What is your safety measure for your proposed control system? Explain the working principle of your safety measure.

(8 Marks)

Question 5

(a) Design a filter system to handle the amount of air required for the makmal tisu kultur using the M-15, 0.6 x 0.6 x 0.2 filter of table in Appendix 2. The pressure loss in the clean condition is assumed as 70 Pa. Determine the modules of filter to be installed.

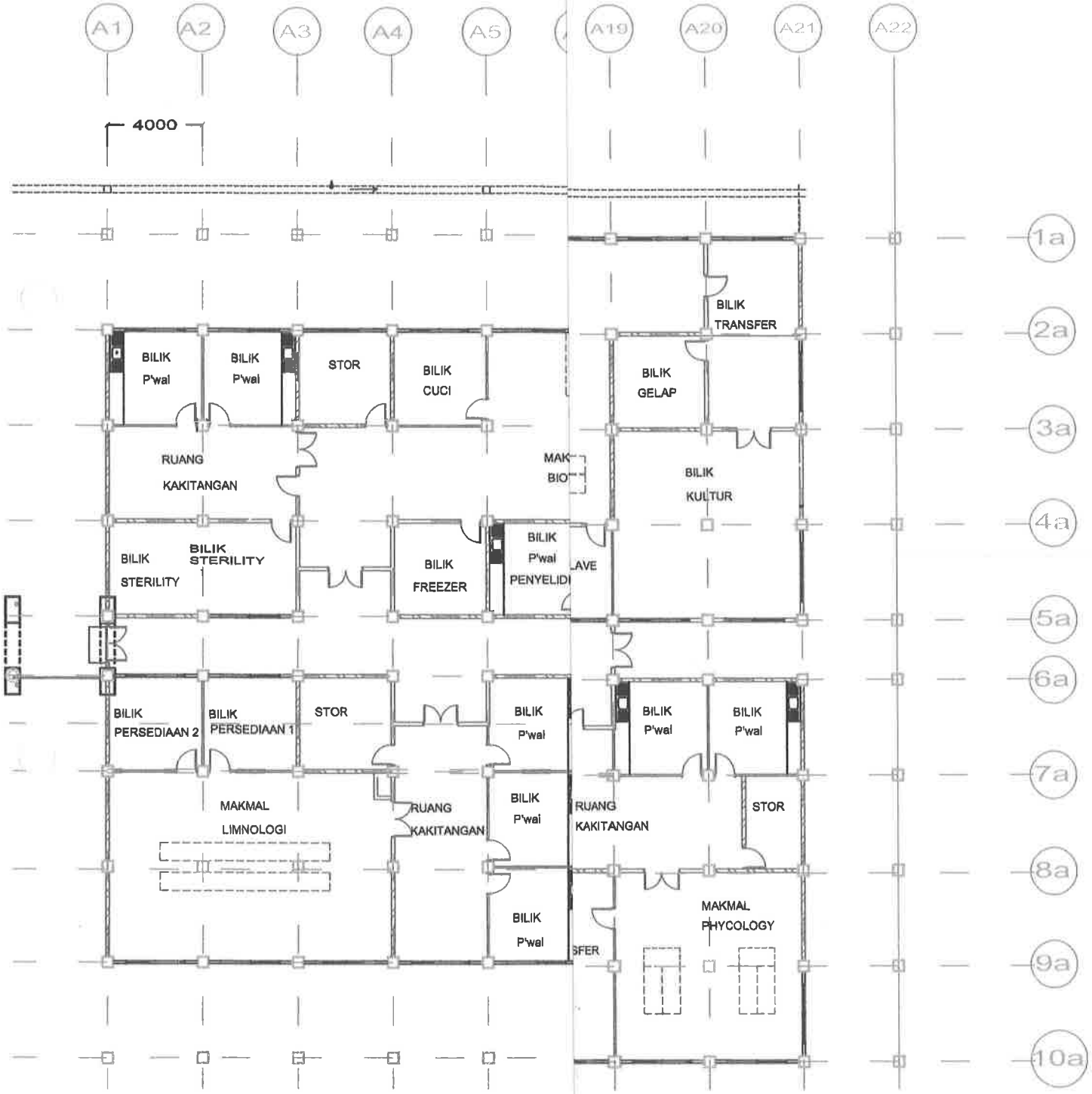
(12 Marks)

(b) Sketch the monitoring device/system to alert your maintenance team when the installed filter is clogged up and need to be replaced.

(8 Marks)

END OF QUESTION

APPENDIX 1: LABORATORY (TO BE RETUR



APPENDIX 2

Table 4-3 Engineering Data—High-Performance Dry-Media Filters (Corresponds to Efficiency Data of Figure 4-4)

Standard Size	Meter Inch	0.3 × 0.6 × 0.2 12 × 24 × 8		0.3 × 0.6 × 0.3 12 × 24 × 12		0.6 × 0.6 × 0.2 24 × 24 × 8		0.6 × 0.6 × 0.3 24 × 24 × 12		Pressure Loss	
Rated Capacity[a]		ft^3/min	m^3/s	ft^3/min	m^3/s	ft^3/min	m^3/s	ft^3/min	m^3/s	Inches of Water	Pa
Media Type	M-2A[b]	900	0.42	1025	0.48	1725	0.81	2000	0.94	0.15	37.4
	M-15	900	0.42	1025	0.48	1725	0.81	2000	0.94	0.35	87.2
	M-100	650	0.30	875	0.41	1325	0.62	1700	0.80	0.40	100.0
	M-200	450	0.21	630	0.29	920	0.43	1200	0.56	0.40	100.0
Effective filtering area		ft^2	m^2	ft^2	m^2	ft^2	m^2	ft^2	m^2		
All media types		14.5	1.35	20.8	1.93	29.0	2.69	41.7	3.87		

[a]Filters may be operated from 50 to 120 percent of the rated capacities with corresponding changes in pressure drop.

[b]The M-2A is available in 2-in. thickness and standard sizes with a nominal rating of 0.28 in. wg at 500 fpm face velocity.

APPENDIX 3

PROPERTIES OF AIR

TABLE E.1
Properties of air at standard atmospheric pressure

Temperature T (°C)	Density ρ (kg/m³)	Specific Weight γ (N/m³)	Dynamic Viscosity μ (Pa·s)	Kinematic Viscosity ν (m²/s)
−40	1.514	14.85	1.51×10^{-5}	9.98×10^{-6}
−30	1.452	14.24	1.56×10^{-5}	1.08×10^{-5}
−20	1.394	13.67	1.62×10^{-5}	1.16×10^{-5}
−10	1.341	13.15	1.67×10^{-5}	1.24×10^{-5}
0	1.292	12.67	1.72×10^{-5}	1.33×10^{-5}
10	1.247	12.23	1.77×10^{-5}	1.42×10^{-5}
20	1.204	11.81	1.81×10^{-5}	1.51×10^{-5}
30	1.164	11.42	1.86×10^{-5}	1.60×10^{-5}
40	1.127	11.05	1.91×10^{-5}	1.69×10^{-5}
50	1.092	10.71	1.95×10^{-5}	1.79×10^{-5}
60	1.060	10.39	1.99×10^{-5}	1.89×10^{-5}
70	1.029	10.09	2.04×10^{-5}	1.99×10^{-5}
80	0.9995	9.802	2.09×10^{-5}	2.09×10^{-5}
90	0.9720	9.532	2.13×10^{-5}	2.19×10^{-5}
100	0.9459	9.277	2.17×10^{-5}	2.30×10^{-5}
110	0.9213	9.034	2.22×10^{-5}	2.40×10^{-5}
120	0.8978	8.805	2.26×10^{-5}	2.51×10^{-5}

Note: Properties of air for standard conditions at sea level are

Temperature	15°C
Pressure	101.325 kPa
Density	1.225 kg/m³
Specific weight	12.01 N/m³
Dynamic viscosity	1.789×10^{-5} Pa·s
Kinematic viscosity	1.46×10^{-5} m²/s