CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

JULY 2010 SESSION

SUBJECT CODE	:	FCB 40102
SUBJECT TITLE	:	INDOOR AIR QUALITY
LEVEL	:	DEGREE
TIME / DURATION	:	3.00pm – 5.30pm (2 ½ HOURS)
DATE	:	12 NOVEMBER 2010

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.

2. This question paper is printed on both sides of the paper.

3. Please write your answers on the answer booklet provided.

4. Answer should be written in blue or black ink except for sketching, graphic and illustration.

5. This question paper consists of FOUR (4) questions. Answer ALL questions.

6. Answer all questions in English

THERE ARE 4 PAGES OF QUESTIONS AND 3 PAGE OF APPENDIX, EXCLUDING THIS PAGE.

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1

Figure Q1 shows the partial layout of a hospital. The ceiling height is 12 ft.

(a)   Propose the ISO Class specification for each room.

(7 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.

(8 Marks)

(c) .   Propose the required airflow and relative room pressure for each room. Based on your

calculation, state the air change per hour and air velocity in each room.

(10 Marks)

Question 2

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

(10 Marks)

(b) Based on your answer in Question 1, sketch the air distribution system for the entire floor. Show the amount of air for every supply air diffuser, return air grille and exhaust air grille in your sketch.

(10 Marks)

(c) Propose and sketch the filtration system for the proposed air conditioning system installed for this area.

(5 Marks)

Question 3

(a) If a stand-alone air conditioning system is required for the operation theatre, design a filter system to handle 25 m³/s of air using the M-15, 0.6 x 0.6 x 0.2 filter of table in APPENDIX. The pressure loss in the clean condition must be 80 Pa or less.

(25 Marks)

Question 4

(a)   What is Sick Building Syndrome?

(5 Marks)

(b)   Name five (5) instruments that being used in performing indoor air quality test in a hospital.

(5 Marks)

(c)   Propose a monitoring device that is used to determine the room pressure which is higher than the adjacent room. Explain the installation of the device in the room.

(5 Marks)

(d)   How to justify that a HEPA filter is clogged up with dirt? Explain your answer with a simple sketch.

(5 Marks)

(e)   Name five (5) methods that can be applied to improve the IAQ in non-industrial workplaces.

(5 Marks)

END OF QUESTION

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

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	
	ft³/min	m³/s	ft³/min	m³/s	ft³/min	m³/s	ft³/min	m³/s	Inches of Water	Pa
Rated Capacity[a] 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	930	0.43	1200	0.56	0.40	100.0
Effective filtering area All media types	ft² 14.5	m² 1.35	ft² 20.8	m² 1.93	ft² 29.0	m² 2.69	ft² 41.7	m² 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.

Figure Q1: Hospital (Must be returned)

STERILE PREP

DISPOSAL

STERILE PREP

STERILE PREP

DISPOSAL

O.T 3

O.T 2

O.T 1

ANAESTHETIC ROOM

SCRUB UP

EXIST LOBBY

ANAESTHETIC ROOM

SCRUB

LOBBY

ANAESTHETIC ROOM

STOR

SISTER

WORK BAY

ORDINARY REST

X-RAY/ DARK ROOM

4527

2499

5934

3576

4400

6058

4237

4247

4247

2308

6121

4247

3320

4247

4247

6509

3587

2436

4247

2760

3360

6286

4400

2499