UNIVOTEC

UNIVERSITY OF VOCATIONAL TECHNOLOGY
Faculty of Industrial & Vocational Technology
Bachelor of Technology in Building Services Technology - 2015 / 2016(B1)
Year I – Semester - I Examination - September - 2015

Building Environment & Human Comfort CT10301

Instructions: All the questions are compulsory. Each question carry 20 marks.
State clearly any assumptions made. Answer Part A and Part B in separate booklets

Duration : 03 hrs

PART A

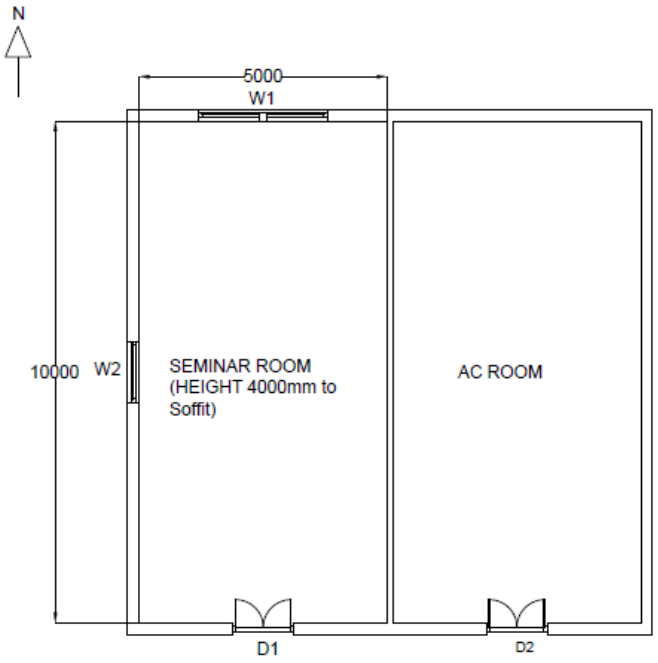
01) Seminar room of the University of Vocational Technology is proposed to be air conditioned and you are requested to calculate the heat load. Preliminary survey is already completed and attached with a sketch for your convenience. Refer to Annex 1.
Seminar room is situated in the ground level of the new building and above is unconditioned space. Occupancy would be 50 people and you may take electrical load for lighting as 16 W/m^2.

i. Calculate **U factor** for the roof. Roof slab comprises followings.
   - 150mm concrete slab having 12.7mm thickness Gypsum plaster below and 9.53mm thickness Cement plaster above.
   - Acoustic tile (0.012m thickness) ceiling (5 marks)

ii. Brick walls thickness 225mm, having 9.5mm thickness Cement plaster and 12.7mm Gypsum plaster. Calculate **U factor** for the wall. (5 marks)

iii. Calculate total heat. (10 marks)

Note:
- Seminar room occupies from 08.00 HRS to 17 HRS.
- Peak month Sept/March, Time 16.00 HRS
- Windows are single glass clear, without shading and take U factor as 5.9 $W/m^2.K$
- Treat the Doors as Windows for heat transfer
- No need to consider ventilation heat.
- Refer Annex 1 and 2 .



Annex 1

02)

i. What is meant by **Thermal Comfort**? (3 marks)

ii. What are the environmental factors affect to thermal comfort. (4 marks)

iii. Briefly explain components of heat inflow. (6 marks)

iv. What is meant by **Clo** value? (3 marks)

v. How does affect building orientation to thermal comfort? (4 marks)

03)

i. Explain why we need better indoor air quality. (3 marks)

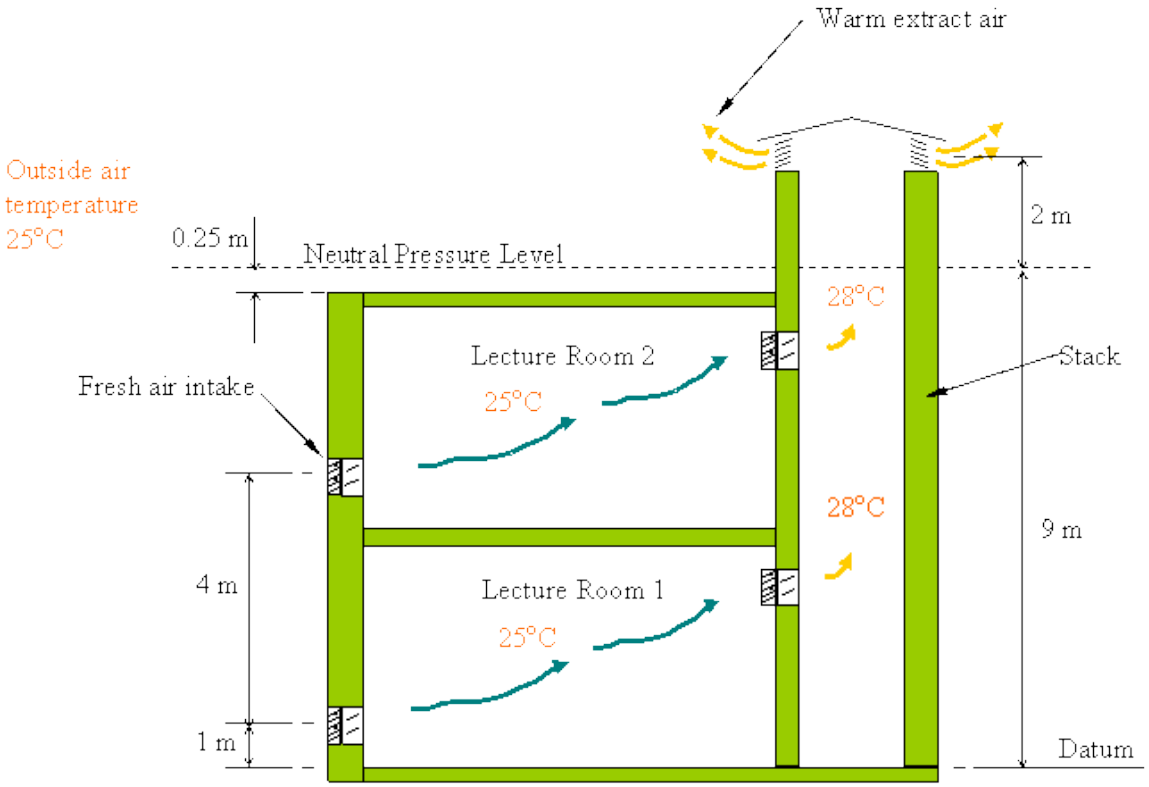
ii. State two methods of improving indoor air quality. (2 marks)

iii. Name three ventilation systems use in practice. (3 marks)

iv. Describe two mechanical ventilation methods. (6 marks)

v. Calculate the ventilation opening area required in a Stack ventilation system for the upper floor in the building shown in **figure 1**. You may take following data.

- The flow rate required each room is 4 air changes per hour.
- Each lecture room measures internally 24 m x 10 m x 4m high.
- Discharge coefficient =0.61
- Air density inside stack = 1.16 kg/m^3
- Acceleration due to gravity = 9.81 m/s^2
- Temperature of air outside stack = 25^{0}C
- Temperature of air inside stack = 28^{0}C (6 marks)



Naturally Ventilated Two Storey Building with Stack

Figure 1

04)

i. Define terms **Illuminance**, **Luminance Intensity** and **Luminous Efficacy** and state their measuring units. (4 marks)

ii. What is the Colour Rendering Index (CRI) (2 marks)

iii. State Inverse Square Law. (2 marks)

iv. Give four factors to measure performance of lamps. (4 marks)

v. Do the basic lighting design calculation for a room having 10x10x4m dimensions. You may take following data.

- Illuminance level = 300 lux.
- Utilization factor = 0.6.
- Light Loss Factor = 0.8
- 18Wx3 fluorescent lighting fixtures.
- Lumen output from a lamp in one fitting = 1100 lm
- Height to working plane = 1m

In your answer, calculate **Room Index** and show it in a layout.

(8 marks)

PART B

05) Acoustics is the science of sound, including its production, transmission and effects. Sound is the sensation that result from rapid fluctuation in the air pressure. These fluctuations all ways proceed with some source of vibration. A vibrating body sets up wave motion in the air.

a. What are the possible three outcomes when sound strikes a surface. (3 marks)

b. What are the two major sound propagation paths. Give two examples for each path. (4 marks)

c. What do you understand by
   (i) Sound Isolation,
   (ii) Decoupling, relates to acoustics (4 marks)

d. (i) Explain briefly what are the three types of noise absorbers (3 marks)

   (ii) Explain your solutions for the Office room interior to arrange it as a noise free environment**.** (6 marks)

DESCRIPTION OF DOORS & WINDOWS		
TYPE	SIZE	DESCRIPTION
W1	2500 x 1200	GLASS
W2	1200 x 1200	GLASS
D1	1200 x 2100	GLASS
D2	1200 x 2100	GLASS

Annex 2

Table 1: Surface Conductance for Air (W/m2.^{0}C)

Position of Surface	Direction of Heat Flow	Resistance
STILL AIR		
Horizontal	Upward	0.11
Vertical	Horizontal	0.12
Horizontal	Downward	0.16
MOVING AIR (Any Position)		
6.7m/s wind (for Winter)		0.030
3.4m/s wind (for Summer)		0.044

Table 2: Thermal Properties of Typical Building and Insulating Materials

Description	Resistance	
	Per thickness	For thickness listed
Mineral fiberboard, wet molded Acoustical Tile	16.52	
Cement plaster , Sand aggregate 9.53mm		0.014
Gypsum plaster 12.7mm		0.056
Concrete, Sand & gravel or stone aggregate	0.76	
Concrete blocks, 3 oval core, Sand & gravel aggregate, 203mm		0.2
Brick	1.39	

Table 3: Maximum Solar Heat Gain Factor, W/m^2 for Sunlit Glass
(For North Latitudes 8 deg. & month March)

North	117
South	174
East	760
West	760

Table 4: Cooling Load Factors for Glass without Interior Shading
(For Medium Construction, 16.00 HRS)

North	0.74
South	0.47
East	0.26
West	0.5

Table 5: Cooling Load Temperature Difference at 16.00 HRS.

Flat concrete roof without suspended ceiling	40
Flat concrete roof with suspended ceiling	34
Wall	5
Glass	5

Table 6: Cooling Load Factors

Lighting fixtures	0.69
Sensible Heat for people	0.72
Latent Heat for people	1

Table 7: Rates of Heat Gain from Occupants of Conditioned Spaces

Degree of Activity	Sensible Heat (Watts)	Latent Heat (Watts)
Seated at rest	60	40
Seated, very light work, writing	65	55

Annex 3