**Cleanroom Design 2nd HW**

**2016/10/28**

**1. A cleanroom with dimension (L\*W\*H) 15m\*30m\*4.5m need to retain 22°C DB, 49% RH, 15Pa static pressure and ISO class 4 @0.5μm cleanliness. The total exhaust airflow rate is VEX, general exhaust (Tex=38°C) is VGEX, acid exhaust (Tex=22°C) is VAEX, base exhaust (Tex=22°C) is VBEX and VOC exhaust (Tex=22°C) is VVEX. (Assume the air density=ρAir) Filter efficiency for pre-filter (ηP) is 50%, mid-filter (ηM) is 85%, final filter-1 (ηF) is 99.97%. Cleanroom particle generation rate is M, and outdoor air particle concentration is COA.** , **Aleakage=1 m2, α=0.5**

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| Figure 1: MAU type cleanroom system |

**A. If VSA = 200,000CMH, FFU dimension is 1.2m\*1.2m, filter surface velocity is 0.5 m/s, please calculate how many FFU (sets) is required and FFU coverage rate (%).** *(4 points each)*

**B. In a MAU cleanroom system, VOA=20,000CMH, VRA=180,000CMH the raised floor has the flow resistance ΔP=10 Pa. The dry cooling coils has the flow resistance ΔP=50Pa. Other pressure loss including flow resistance at return air shaft, supply air plenum, returns air plenum is 25 Pa. Assume the FFU efficiency is 50%.**

**a. Please estimate the minimum external static pressure of the FFU should have.** *(4 points)*

**b. If the flow resistance of filter is 90 Pa under the 0.4 m/s filter surface velocity. Find the minimum static pressure (Pa) should the fan of the FFU has (that is FFU pressure rise). And single FFU power input requirement (kW) (Hint:)** *(4 points each)*

**C. The lighting power demand is 40W/m2, process tool generates 1200 kW heat, and 20 operators working in cleanroom, each of them generates 300W sensible heat. Process cooling water (PCW) removes 60% heat from process tool, DCC and exhaust air removes the rest 40%.**

**a. Cleanroom particle generation rate is 2x104 #/s,** **and outdoor air particle concentration is 1x108 #/m3. If VEX=60,000CMH, find the cleanroom leakage airflow rate (Vinf), MAU supply airflow rate (VOA) and required cleanroom supply air flow rate VSA to achieve particle concentration control and room temperature control. (assume temperature difference is 2°C when air passing through cleanroom).** *(4 points each)*

Table 1 Exhaust air volume flow rate

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| Item | Flow rate (CMH) |
| GEX | 30,000 |
| AEX | 10,000 |
| BEX | 10,000 |
| VEX | 10,000 |

**b. If return air temperature is 23°C, MAU supply air temperature is 16°C find the mixed air temperature (°C) and the air temperature after air pass through DCC (°C)** *(4 points each)*

**c. If the DCC water temperature difference is 2°C, find DCC water flow rate (L/s).***(4 points)*