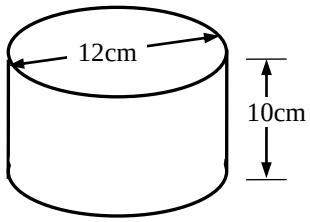
Department of Mechanical Engineering
MECH 375: Heat Transfer-1 [30% of the Total Marks]

Notes: This is an **only** open textbook exam.**Only summary sheets provided by instructor *attached* to this exam are allowed;** Exam period: 50 min

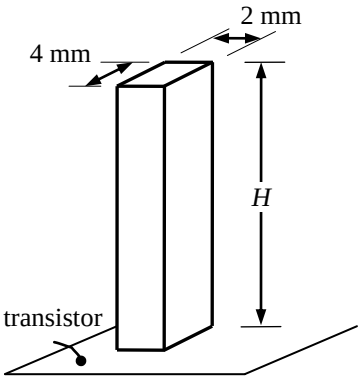
Problem 1 (50%)

A can of vegetables 12 cm in diameter and 10 cm high is initially at 40°C (uniform), and is to be sterilized by immersion in hot air at 110°C ($h = 470\,\mathrm{W/m^2\text{-}K}$). Find the time required for the minimum temperature in the can reaches 90°C. Thermophysical properties of the vegetables approximate those of water. A table for water property data is attached on the next page.



Problem 2 (50%)

12 identical aluminum alloy fins, each 4 mm wide, 2 mm thick are used to cool a transistor of 30 mm × 20 mm surface area. The steady-state surface temperature of the transistor is 80°C and can be assumed uniform. The ambient air is at 25°C, and the heat transfer coefficient for convection in air is $h = 14\,\mathrm{W/m^2\text{-}K}$. Radiation heat transfer is negligible. The fin-transistor thermal contact is excellent. The alloy has a thermal conductivity of 165 W/m-K. It is desired to obtain a fin effectiveness of 20.



a) What would be the height of each fin?
b) What percentage of the total heat loss to air from the transistor surface is through the fins?

Good Luck!

TABLE 13 Water at saturation pressure

Temperature, T			Density, ρ (kg/m^3)	Coefficient of Thermal Expansion, $\beta \times 10^4$ (1/K)	Specific Heat, c_p (J/kg K)	Thermal Conductivity, k (W/m K)
°F	K	°C				
32	273	0	999.9	−0.7	4226	0.558
41	278	5	1000	—	4206	0.568
50	283	10	999.7	0.95	4195	0.577
59	288	15	999.1	—	4187	0.585
68	293	20	998.2	2.1	4182	0.597
77	298	25	997.1	—	4178	0.606
86	303	30	995.7	3.0	4176	0.615
95	308	35	994.1	—	4175	0.624
104	313	40	992.2	3.9	4175	0.633
113	318	45	990.2	—	4176	0.640
122	323	50	988.1	4.6	4178	0.647
167	348	75	974.9	—	4190	0.671
212	373	100	958.4	7.5	4211	0.682
248	393	120	943.5	8.5	4232	0.685