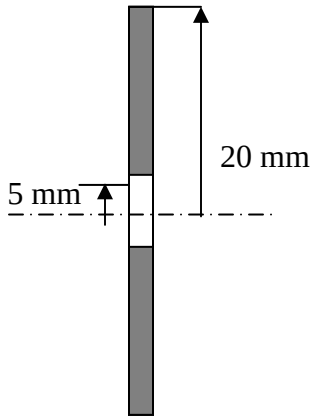
Lebanese American University
School of Engineering and Architecture
Department of Mechanical Engineering

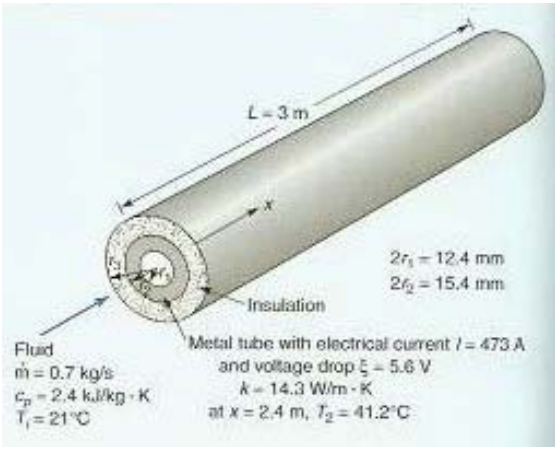
MEE 304 HEAT TRANSFER
First Midterm, Duration 100 min

Name: **April 08, 2008** **ID:**

1- (25 pts) An aluminum annular fin is used to cool a transistor. The inner and outer radii are 5 mm and 20 mm, respectively, and the thickness is 0.2mm. Calculate its efficiency ad the heat dissipated when its base is at 380 K, the ambient air temperature is 300 K, and the estimated heat transfer coefficient is 8.2 W/m^2 K. take the conductivity of aluminum as 205 W/mK. DO NOT USE FIGURES FOR COMPUTING η.



2-(25 pts) We want to determine experimentally the heat transfer coefficient of a single-phase fluid flowing inside a straight circular tube. The tube is 3 m long, has a 12.4-mm inner diameter and a 15.4-mm outer diameter, and is well insulated. The tube's thermal conductivity is 14.3 W/m.K. The fluid (c_p=2.4 kJ/kg.K) enters the tube at 21^{o}C at a flow rate of 0.7 kg/s. Electric current heats the tube; the current is I= 473 A, and the voltage drop across the length of the tube is ξ=5.6V. At a distance of 2.4 m from the inlet, the measured temperature on the outside surface of the tube is 41.2^{o}C. Determine the heat transfer coefficient at the location (in W/m^2.K)



3-(25 pts) The free convection heat transfer coefficient on a thin hot vertical plate suspended in still air is 6.4 W/m^2.K and the surroundings temperature is 25^{o}C. Assuming the plate is isothermal with an emissivity of ε = 0.42. Evaluate the time rate of change of the plate's temperature when its temperature is 225^{o}C. Also evaluate the heat loss by convection and the heat loss by radiation.

4)-(25 pts) A 16 mm-square chip has sixteen 2 mm-diameter, 15 mm-long aluminum pin fins in an aligned array at a pitch of 4 mm. A fan blows 25^{o}C air through the array, giving a heat transfer coefficient of 110 W/m^{2} K. If the chip is not to exceed a 75^{o}C operating temperature, what is the allowable power rating of the chip?