University of Al-Qadisiyah

College of Engineering

Mechanical Engineering Department

Class: Third

Subject: Heat Transfer

Examiner: Dr Khaled Al-Farhany

Time: 2 Hours

Date: 21 / 01 / 2017

First Semester Exam 2015-2016

Note: Attempt all questions

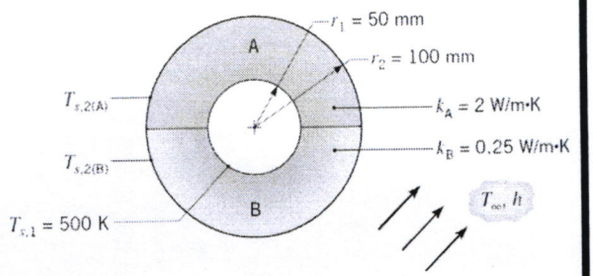
Q1: Define the following: **(20 marks)**

1- *critical radius* 2- *Fin Efficiency* 3- *Long fin*

Q2: Answer one only: **(20 marks)**

(a) Derive the expression of steady state one-dimension heat conduction equation of spherical coordinate without heat generation.

(b) Steam flowing through a long, thin-walled pipe maintains the pipe wall at a uniform temperature of 500 K. The pipe is covered with an insulation blanket comprised of two different materials, A and B. The entire outer surface is exposed to air for which T= 300 K and h= 25 W/m^2.K. Find the thermal resistance of the system and the total heat loss and the outer surface temperatures $T_{s,2(A)}$ and $T_{s,2(B)}$?

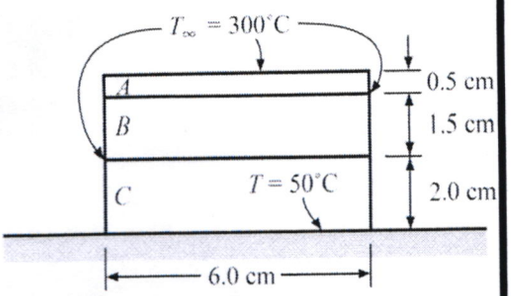


Q3: **(20 marks)**

A semi-infinite slab of copper ($k = 386\ w/m.^\circ C$, $\alpha = 11.23 \times 10^{-5}\ m^2/s$) is exposed to a constant heat flux at the surface of 0.5 MW/m^2. Assume that the slab is in a vacuum, so that there is no convection at the surface. What is the surface temperature after 5 min if the initial temperature of the slab is 20◦C? What is the temperature at a distance of 15 cm from the surface after 5 min?

Q4: **(20 marks)**

The composite strip in Figure below is exposed to the convection environment at 300◦C and h=40 W/m^2.◦C. The material properties are k_A =20 W/m· ◦C, k_B =1.2 W/m.◦C, and k_C =0.5 W/m.◦C. The strip is mounted on a plate maintained at the constant temperature of 50◦C. Calculate the heat transfer from the strip to plate per unit length of strip. Assume two-dimensional heat flow.

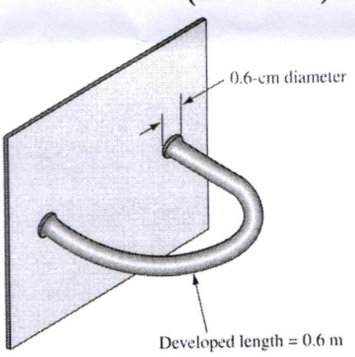


Q5: **(20 marks)**

Both ends of a 0.6-cm copper U-shaped rod are rigidly affixed to a vertical wall as shown in the accompanying sketch. The temperature of the wall is maintained at 93°C. The developed length of the rod is 0.6 m, and it is exposed to air at 38°C. The convection heat transfer coefficient for this system is 34 W/m^2 K.

(a) Calculate the temperature of the midpoint of the rod.

(b) What will the rate of heat transfer from the rod be?



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Good luck!!!