Indian Institute of Technology (B.H.U)

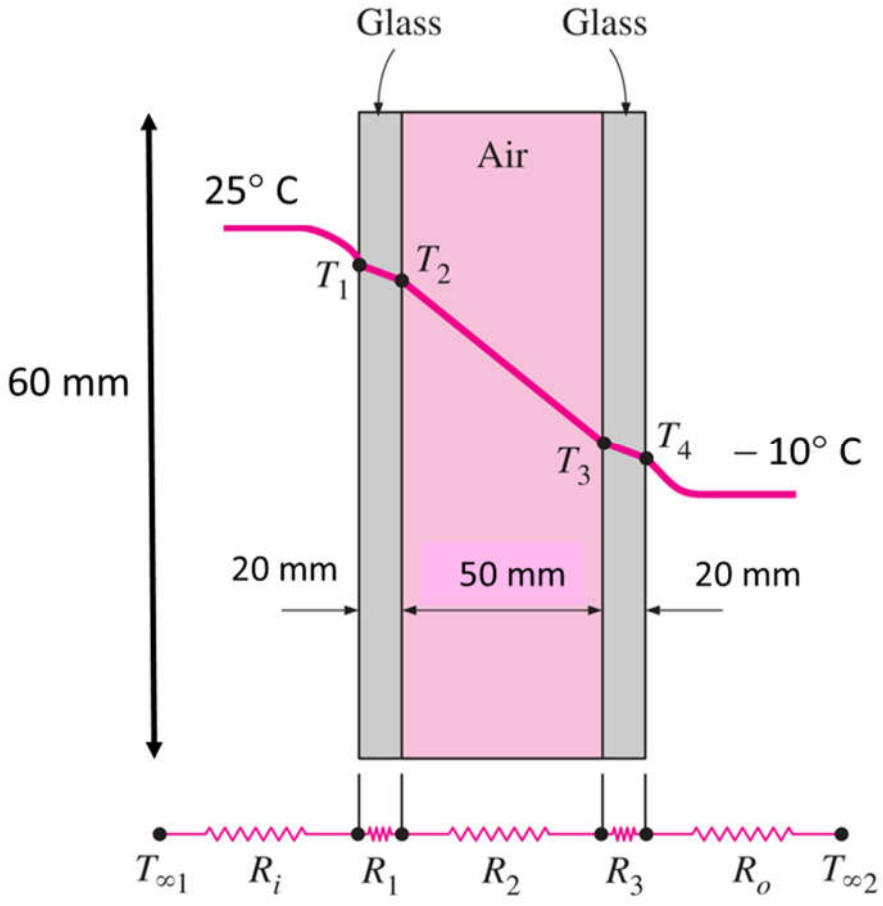
Sub: **Numerical Heat Transfer & Fluid Flow** (ME 4205/5239)

CFD class test

Duration: 2 hours Marks: 70

Instructions:

- You are allowed to use internet, any book, mobile, calculator etc.
- You are not allowed to talk to your friends, share any information etc.
- Do not write anything on the question paper except your name.
- Mention your set number in the answer sheet. If not mentioned, set A will be assumed by default.
- Evaluation will be done during the exam hours and based on the report you submit. Report creation instruction is given below.
- To create the report, create a ppt file with name: your_name_roll_no.ppt. After the exam, save as this file in .pdf format. This pdf file has to be sent via email (stccfdfem@gmail.com) just after the exam. File not received within 5 minutes after exam will not be considered.
- In the email subject line, mention: **CFD Class test 2017**
- **Slide 1** should contain: your details, roll no., mobile no., email id etc.
- For slide 2 onwards, instructions are given below.
- All the files (.hm, .sim, and .ppt) should also be put in the Dropbox/Google drive account immediately after the exam. The pdf and ppt file should match when compared.



Questions:

1. Consider a 60 mm high and 40 mm wide double-pane window consisting of two layers of glass (k = 1 W/m · °C) separated by a stagnant air space (k = 0.026 W/m · °C). Take the convection heat transfer coefficients on the inner and outer surfaces of the window to be h_1 = 10 W/m^2 · °C and h_2= 40 W/m^2 · °C, which includes the effects of radiation.

   A. Design the above double-pane using any software. Show the image with dimensions (use can use Dimension box icon) **(Slide 2) (Mark 10)**
   B. Mesh the above design with 1 mm element size. Show the meshed image **(Slide 3) (Mark 5)**
   C. Develop a 2D model to study *conduction heat transfer* in the above model. Do not switch gravity. Show the volume mesh image **(Slide 4) (Mark:5)**
   D. Show the temperature contour of the above system. What is the interface wall temperature near the air gap? Also find the interface temperature theoretically using thermal resistance concept. **(Slide 5, 6, 7) (Mark: 10)**
   E. Show the heat transfer rate through any window. **(Slide 8) (Mark:5)**

2. In the question 1 above, now model the phenomena of heat transfer due to convection in the air gap.
   A. Show the temperature contour of the above system. What is the interface wall temperature near the air gap? **(Slide 9) (Mark: 10)**
   B. Show the temperature plot variation at the mid of the window along the width. Show both the plots of temperature (in question 1 and question 2) in the same graph. In which case you expect to have higher interface wall temperature near the air gap and why? Explain with the help of temperature variation plot. **(Slide 10) (Mark: 10+5 = 15).**
3. Model air gap in question 1 with contact resistance concept.
   A. Calculate the equivalent contact resistance of the air? **(slide 11) (Mark: 5)**
   B. Show the temperature contour **(slide 12) (mark: 10)**