Name: _____

EXAM IV
Radiative Heat Transfer

Thursday November 3, 2005
Closed Book, Closed Notes

Instructions

1. This exam is closed books and closed notes. Test notes are provided.
2. Write on the exam script only. Extra paper can be obtained from the instructor. Write ONLY on the front side of each page. Do not separate pages of the exam; do not remove staples from the exam.
3. On all graphs, be absolutely *neat* and *clear* about distinguishing features, curvature, relative magnitudes and labels.
4. Clearly indicate the part of the problem, i.e. a, b, etc., to which your analyses correspond.
5. Reference any figures, charts or tables from the test notes.
6. Show all work. Show *all* equations in symbolic form, all numerical substitutions, and all calculations.

GOOD LUCK!

Problem	Points	Possible
1		3
2		17
3		30
Total		50

Problem 1

(a) In reference to radiative heat transfer, answer the following questions:

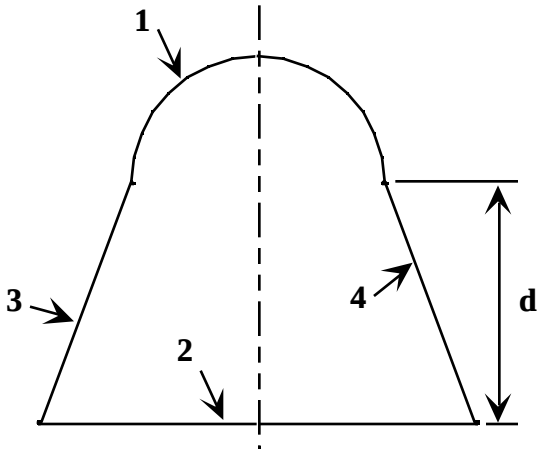
(i) In words, what is the definition of radiosity?

(ii) In words, what is the definition of a diffuse surface?

(iii) What form of Kirchoff's Law is valid for a diffuse gray surface?

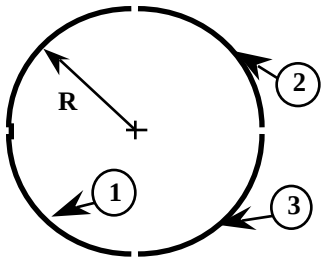
Problem 2

An infinitely-long semi-cylindrical surface (surface 1) having radius b and an infinitely-long flat plate (surface 2) having half-width c, where c>b, are located a distance d apart. Surfaces 3 and 4 connect these two surfaces as shown. Determine the view factors F_{11}, F_{12}, F_{13}, F_{14}, F_{21}, F_{22}, F_{23}, and F_{24}. For each view factor calculation, clearly draw the surfaces and label the distances involved. Use the cross-strings method where appropriate and do not use any pre-derived equations in any tables provided in the test notes. Clearly draw a box around the final answer for each view factor.



Problem 3a

An infinitely-long cylinder of radius R consists of three isothermal sections with a one-half section (surface 1) and two quarter sections (surfaces 2 and 3) as shown. Surfaces 1 and 3 are maintained at T_1 and T_3, respectively, while surface 2 is insulated. All surfaces have an emissivity ε. Sketch the radiation network, clearly labelling all nodes, resistances and heat transfer rates in symbolic form. Determine the net rate of heat transfer to surface 1 per unit length, assuming that all view factors are known.



Problem 3b

To decrease the net rate of heat transfer, a radiation shield (surface 4) is inserted in the middle of the cylinder as shown. Sketch the thermal resistance network for radiant exchange between these surfaces, clearly labelling all nodes, resistances and heat transfer rates in symbolic form. Under the same conditions as Problem 3a, write an equation for the rate of heat transfer to surface 1 per unit length, assuming that all view factors are known.