School of Information Technology
IIT Kharagpur

Course Id: IT60101 Foundations of Computing Systems

Date: August 29, 2005                   Total Time: 60 minutes
Max. Marks: 45

Instructions: Answer all questions. You may answer the questions in any order. However, all parts of the same question must be answered together. Clearly state any reasonable assumption you make.

1. (a) Write the recurrence relation for merge sort.
    (b) Solve it using (i) Substitution Method and (ii) Master Method

[2+4+4=10]

2. Use master method to give tight asymptotic bounds for the following recurrence:

    \[ T(n) = 4T(n/2) + n^2 \]

[5]

3. (a) Write an algorithm for performing Merge sort.
    (b) Clearly state the Loop Invariant for the merging routine.
    (c) Show that the Loop Invariant holds for initialization, maintenance and termination.

[5+5+5=15]

4. (a) Clearly state what you mean by the following
        (i) \( g(n) = O(f(n)) \) and (ii) \( g(n) = \omega(h(n)) \)
    (b) Prove that \( o(g(n)) \cap \omega(g(n)) = \emptyset \)

[5+5+5=15]