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Ph.D Admission Test
Sample Question Paper
Computer Science and Engineering

SAMPLE QUESTION PAPER

Objective: The focus of our admission test is to test your aptitude for research and problem solving skills.

Data Structures and Algorithm(Common for ECE and CSE)

1. What is the solution to the recurrence $T(n) = T(n-1) + 2$, $T(1) = 2$
2. Solve: $T(n) = 4T(n/2) + n \log n$, $T(1) = 1$.
3. Say True or False.
   - $3n^2 + 4n + 1 = O(n^3)$
   - $n + 1 = \Omega(logn)$
   - $n = \Omega(n^2)$
   - $n^2 + 1 = O(n)$
4. The worst-case time to search an element in a binary heap of height h with n elements is $O(n)$.
5. Given a binary tree with l leaves, find the number of internal nodes (including root) as a function of l.
6. Let A be a sorted linked list and A' be an unsorted linked list. Inserting an element x into A (the resultant A must still be a sorted list) is efficient than inserting x into A'. Say True or false.

Computer Organization (Common for ECE and CSE)

1. True or False: Addition of a non-negative number with a negative number will never generate a carry.
2. The following three lines of *partial* code is expected to swap two variables. Complete the code. (i) $a = a \ \ xor \ \ b$ (ii) $b = b \ \ xor \ \ a$ (iii)...
3. Perform Booth's Multiplication: 1 0 1 0 0 1 0 1 $\times$ 1 1 1
4. Identify the errors in the following code (it assumes 8085 instruction set)
   - MOV A,B
   - LOAD C,2000
   - MOV D,3000
   - MOV 2500,A
5. For the following specification with set associative mapping strategy, identify the number of bits in fields **Tag**, **set**, and **word**.
   - Cache size: 64 KB RAM size: 512 MB Block size: 4 KB Word size: 4 Bytes
   - 4-way Set-associative mapping

Programming/Algorithms(Common for ECE and CSE)

1. In the following Pseudo code, how many times the statements *for* and *print* are executed.

```
void fnprint()
```

{ `for` int i=1 to 5

`print` i;

}

2. Write a recursive program to print all permutations of a finite set.

3. Is it possible to write a C-program to print the set of natural numbers. Is it possible to write a C-program to print the set of Real numbers. Justify.

4. At the termination of the following program, what is the value of *count*.

int n; `/*-- Input` n`--*/`

count-function()

`int` i=1, count=0;

`while` $(i \leq n)$

{

i = i * 2;

count ++;

}

5. Given a finite array A, the function `SWAP(A[i],A[j])` swaps the contents of `A[i]` with `A[j]` (Assume that the array is passed by reference). How do you use SWAP to reverse the contents of A.

Discrete Mathematics (For CSE only)

1. Let $A = \{1, 2, 3\}$ and $R = \{(1, 2), (1, 3)\}$ be a binary relation defined on A. Is R transitive?

2. Let $A = \{1, 2\}$ and $R = \{(1, 1), (2, 2)\}$ be a binary relation defined on A. Professor X says R is an equivalence relation. Is Professor X right?.

3. Count the number of permutations of the letters in 'admission'.

4. Two logical statements $S1$ and $S2$ are defined as follows: $S1$: If 3+2=5, then it rains on Sunday. $S2$: 3+2=5. What logical inferences can you make from $S1$ and $S2$.

5. Count the number of one-one functions and onto functions (Assume the size of domain is m and the codomain is n).

Digital Signal Processing (For ECE only)

1. Given $f \otimes g$ and also g, how do you find f? where $\otimes$ means convolution.

2. What is the difference between convolution and correlation?

3. Is mean filter linear? Justify your answer.

Detailed Syllabus (Common for ECE and CSE)

`Data Structures:` ADT, Lists, Heaps, Binary trees, Graphs.

`Algorithms:` Time-complexity Analysis, solving recurrence relations, searching, sorting, algorithm design paradigms, basics of NP-completeness.

`Computer Organization:` Fixed/Floating point addition/subtraction/multiplication/division, addressing modes, cache memory (placement/replacement algorithms), pipelining, and hazards.

`C-Programming:` Iterative and recursive programs, structures, and pointers

`Discrete Mathematics:` (For CSE only) Sets, Relations, Functions, Counting, and First Order Logic, Proof Techniques, Automata theory.

`Digital Signal Processing` (For ECE only) Signals and Systems, transformations, filters, processor architectures, 2-D signal processing.