# COURSE HANDOUT

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| Course Code | ACSC13 |
| Course Name | Design and Analysis of Algorithms |
| Class / Semester | IV SEM |
| Section | A-SECTION |
| Name of the Department | CSE-CYBER SECURITY |
| Employee ID | IARE11023 |
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| Topic Covered | Divide and Conquer |
| Course Outcome/s | Apply the strategy of divide-on-conquer |
| Handout Number | 15 |
| Date | 15 April, 2023 |

## Content about topic covered: Divide and Conquer

### Divide and Conquer

The divide and conquer technique can be dividing the inputs into k different subsets, with $1 < k \leq n$ giving k subproblems, given a function to compute on n inputs. After resolving these smaller problems, a way must be found to bring the smaller solutions together to address the large problems.

### Control Abstraction

A process whose basic actions are specified by another procedure whose specific meanings are not defined but whose control flow is evident.

Control abstraction for divide and conquer:

```
Algorithm DAndC(P)
{
        if Small(P) then reurn S(P);
        else
        {
                Divide P into smaller instances P1, P2, … , Pk, k ≥ 1
                Apply DAndC to each of these subproblems;
                Return Combine(DAndC(P1), DAndC(P2), … , DAndC(Pk));
        }
}
```

The boolean function Small(P) determines whether the input size is small enough to allow computation of the result without splitting. Using the answers to the k subproblems, the combine function finds the answer to P.

The recurrences of the form determine the difficulty of numerous divide and conquer algorithms.

$$T(n) = \begin{cases} T(1) & n = 1 \\ a\,T\left(\frac{n}{b}\right) + f(n) & n > 1 \end{cases}$$

If the problem is divided in to two sub problems of equal size, then the computing time of DAndC is described as

$$T(n) = \begin{cases} g(n) & if\ n\ is\ small \\ 2\,T\left(\frac{n}{2}\right) + f(n) & otherwise \end{cases}$$

Where T(n) is the time for DAndC on n inputs, g(n) is the time to compute the answer directly for small inputs and f(n) is the time for Divide and Combine.