**SQL Server and Query Performance and Optimization Syllabus**

**Module-1: SQL Query Performance Killers, Query Tuning and Optimization Process**

* **SQL Server Architecture**
* **Query Optimizer Role in SQL Server Architecture**
* **Server and Database Level Settings for Optimized Performance**
* **The Performance Tuning Process**
* **Performance Baseline**
* **SQL Server Performance Killers**

**Module-2: SQL Server Optimization Checklist**

**Database Design**

* **Balancing Under- and Over normalization**
* **Benefiting from Entity-Integrity Constraints**
* **Benefiting from Domain and Referential Integrity Constraints**
* **Adopting Index-Design Best Practices**
* **Avoiding the Use of the sp\_ Prefix for Stored Procedure Names**
* **Minimizing the Use of Triggers**

**Module-3: Query Design**

* **SET NOCOUNT ON**
* **Explicitly Define the Owner of an Object**
* **Avoid Nonsargable Search Conditions**
* **Avoid Arithmetic Expressions on the WHERE Clause Column**
* **Avoid Optimizer Hints**
* **Stay Away from Nesting Views**
* **Ensure No Implicit Data Type Conversions**
* **Minimize Logging Overhead**
* **Adopt Best Practices for Reusing Execution Plans**
* **Adopt Best Practices for Database Transactions**
* **Eliminate or Reduce the Overhead of Database Cursors**

**Module-4: SQL Server Configuration Settings**

* **Affinity Mask**
* **Memory Configuration Options**
* **Cost Threshold for Parallelism**
* **Max Degree of Parallelism**
* **Optimize for Ad Hoc Workloads**
* **Fill Factor (%)**
* **Blocked Process Threshold**
* **Database File Layout**
* **Database Compression**
* **Keep the Statistics Up-to-Date**
* **Maintain a Minimum Amount of Index Defragmentation**
* **Cycle the SQL Error Log file**
* **Avoid Database Functions Such As AUTO\_CLOSE or AUTO\_SHRINK**
* **Database Backup**
* **Incremental and Transaction Log Backup Frequency**
* **Backup Distribution**
* **Backup Compression**

**Module-5:: Working with Execution Plan to Tune and Optimize SQL Queries**

**Execution Plan**

* **Execution Plan Generation**
* **Parser**
* **Binding**
* **Optimization**
* **Components of the Execution Plan**
* **Aging of the Execution Plan**
* **Analysing the Execution Plan Cache**
* **Execution Plan Reuse**
* **Ad Hoc Workload**
* **Optimize for an Ad Hoc Workload**
* **Forced Parameterization**
* **Benefits of Stored Procedures**
* **sp\_executesql**
* **Parameter Sniffing**
* **Query Plan Hash and Query Hash**
* **Execution Plan Cache Recommendations**

**Actual vs. Estimated Execution Plans**

**SET STATISTICS TIME**

**SET STATISTICS IO**

**Module-6: Indexes and Statistics, Index Types and Their Role in Query Optimization**

**Index Analysis**

* **What Is an Index?**
* **Index Design Recommendations**
* **Clustered Indexes**
* **Nonclustered Indexes**
* **Clustered vs. Nonclustered Indexes**
* **Advanced Indexing Techniques**
* **Columnstore index**

**Index Fragmentation Analysis**

* **Causes of Fragmentation**
* **Fragmentation Overhead**
* **Analysing the Amount of Fragmentation**
* **Analysing the Fragmentation of a Small Table**
* **Fragmentation Resolutions**
* **Significance of the Fill Factor**
* **Automatic Maintenance**

**Module-7: Statistics Analysis**

* **The Role of Statistics in Query Optimization**
* **Statistics on a Nonindexed Column**
* **Analysing Statistics**
* **Statistics Maintenance**
* **Statistics Maintenance Status**
* **Analysing the Effectiveness of Statistics for a Query**

**Module-8: Lookup Analysis and Joins in Query Plan**

* **Purpose of Lookups**
* **Drawbacks of Lookups**
* **Analysing the Cause of a Lookup**
* **Resolving Lookups with Covering Index**

**Module-9: Operators**

* **Table Scan**
* **Index Scan**
* **Index Seek**
* **Key Lookup**
* **RID Lookup**
* **Stream Aggregate**
* **Hash Match Aggregate**
* **Concatenate**
* **Sort**
* **Assert**
* **Filter**
* **Online Index Insert**
* **Hash join**
* **Merge join**
* **Nested loop join**
* **Segment**
* **Lazy Spool**
* **Eager Spool**

**Module-10: Analysing Join Effectiveness**

* **Hash joins**
* **Merge joins**
* **Nested loop joins**

**Module-11: Query Recompilation**

* **Benefits and Drawbacks of Recompilation**
* **Identifying the Statement Causing Recompilation**
* **Analysing Causes of Recompilation**
* **Explicit Use of RECOMPILE**
* **Avoiding Recompilations Caused by Statistics Change**

**Module-12: Improving query Performance with :( applicable for SQL Server 2014 and beyond)**

* **In-Memory Optimized Tables and**
* **Natively Compiled Stored Procedures**

**Module-13: Understanding Locks, Blocking, Deadlocking and Isolation Levels in SQL Server**

* **Isolation Levels in SQL Server**
* **Locks and Blocking Analysis**
* **Locks**
* **Lock Operations and Modes**
* **Lock Granularity**
* **Isolation Levels**
* **Blocking**
* **Capturing Blocking Information**
* **Blocking Resolutions**
* **Automation to Detect and Collect Blocking Information**
* **Deadlock Analysis**
* **Deadlock Fundamentals**
* **Using Error Handling to Catch a Deadlock**
* **Collecting Deadlock Information**
* **Analysing the Deadlock**
* **Avoiding Deadlocks**

**Module-14: Tools in SQL Server Used in Performance Optimization**

* **Query Plan**
* **SQL Profiler**
* **Xtended Events**
* **Plan Guide**
* **Live Query (introduced in 2016)**
* **Query Store (introduced in 2016)**

**Module-15: Troubleshooting CPU, Memory and I/O Performance Issues using Performance Mointor Counters and Waits**

* **Troubleshooting CPU Performance**

**Understanding:**

* **SQLOS**
* **Scheduler**
* **Pre-emptive Scheduler**
* **Cooperative Scheduler**
* **Quantum**
* **Scheduling of threads and scheduler**
* **Scheduling Algorithm**
* **Thread Life Cycle**
* **Max Degree of Parallelism**
* **Cost Threshold for Parallelism**
* **CPU waits: SOS\_Scheduler\_Yeild and**
* **CXPACKET**
* **Signal\_wait\_time\_ms**
* **Troubleshooting Memory Performance**
* **Troubleshooting I/O Performance**
* **Troubleshooting TempDB Performance**