KOENIG SOLUTIONS · COURSE OUTLINE

Microsoft SQL Server 2025: Enterprise Database Performance Optimization

Microsoft SQL Server 2025: Enterprise Performance & Query Optimization (40 Hours)

5 Days	20	80	9
40 HOURS	MODULES	TOPICS	HANDS-ON LABS

COURSE OVERVIEW

Maximize the performance and efficiency of your SQL Server 2025 environments with this advanced 40-hour program tailored for enterprise DBAs, database engineers, and performance specialists. Participants gain deep insights into SQL Server 2025 engine internals, query processing, indexing, and workload optimization, enabling them to troubleshoot and prevent performance bottlenecks in real-world scenarios. The curriculum covers core architectural concepts, query execution and plan stability, Intelligent Query Processing (IQP), batch mode, vector indexing, columnstore enhancements, and tempdb governance. Advanced modules focus on plan cache management, deadlock analysis, resource governance, and continuous optimization strategies. Hands-on labs simulate enterprise-level performance challenges, from slow queries and blocking to mixed OLTP-analytics workloads, ensuring participants acquire practical, actionable skills that can be immediately applied in production environments.

WHO THIS COURSE IS FOR

Database Administrators | **Database Engineers** | **Performance Specialists** | **Database Architects**

LEARNING OBJECTIVES

- Explain SQL Server 2025 storage, memory and query processing internals
- Apply waits and queues methodology to isolate performance bottlenecks
- Configure indexing strategies including columnstore and vector indexes
- Implement batch mode optimization for hybrid OLTP and analytics workloads
- Analyse execution plans and detect plan regressions
- Apply Intelligent Query Processing features such as PSP and OPPO
- Diagnose locking, blocking and deadlock scenarios
- Plan tempdb configuration and resource governance for workload management

COURSE SYLLABUS

20 Modules, 80 Topics

DAY 1 SQL Server 2025 Architecture, Query Processing & Waits Framework

01

SQL Server 2025 Internal Architecture

TOPICS

- SQL Server core architectural components
- **Storage Engine internals:** pages, extents, buffer pool, checkpoints
- Query Processing Engine and execution pipeline
- **Memory internals:** workspace memory, cache stores
- Scheduling (SOS), workers, tasks
- Transaction Log architecture and log flow

02

Lab

Waits & Queues Methodology

TOPICS

Scheduling, workers, tasks, worker lifecycle · Key wait types for CPU, IO, memory, blocking · Using waits to isolate systemic bottlenecks

DAY 2 Indexing, Columnstore, Vector Indexing & Batch Mode Optimization

03

Indexing Strategy in SQL Server 2025

TOPICS

Rowstore vs columnstore vs hybrid indexing · Covering, filtered, composite index patterns · SQL 2025 engine-driven indexing changes

04

Columnstore Enhancements & Memory Optimize Container

TOPICS

- Ordered Nonclustered Columnstore Indexes (NCCS)
- Online columnstore maintenance improvements
- Advanced segment elimination
- Columnstore use cases for analytics and hybrid workloads
- Memory-optimized container and filegroup removal

05

Vector Indexing

TOPICS

CREATE VECTOR INDEX · Embedding-based search patterns · Querying vector-augmented datasets

06

2 Labs

Batch Mode & Hybrid Workload Optimization

TOPICS

- Batch mode performance improvements in SQL 2025
- Batch mode on rowstore
- Performance characteristics for JSON, vector, and relational workloads

DAY 3

Engine Enhancements, Plan Stability, Query Store, Plan Cache & Concurrency

07

SQL Server 2025 Engine Performance Improvement

TOPICS

- Storage engine and memory improvements
- Buffer pool and memory subsystem optimizations
- **Optimized Locking:** Transaction ID Locking, Lock After Qualification
- Columnstore engine enhancements
- OLTP vs OLAP performance considerations
- ZSTD compression algorithm introduced in SQL Server 2025

08

Execution Plan Concepts

TOPICS

- Estimated, actual and live plans
- Operators, cardinality, and cost model fundamentals
- Detecting plan regressions and anti-patterns

09

Intelligent Query Processing (IQP) in SQL 2025

TOPICS

IQP evolution · CE Feedback for expressions · Optional Parameter Plan Optimization (OPPO) · Parameter Sensitive Plan Optimization (PSP) · Adaptive Query Processing enhancements

10

Query Store & Automatic Tuning

TOPICS

Query Store improvements in SQL 2025 · Automatic tuning and plan correction · Detecting and preventing plan regression

11

Plan Cache Internals

TOPICS

Plan cache architecture, cache stores · Identifying cache bloat · Troubleshooting using cache metadata · Forced parameterization and reuse strategies

12

Compilation Storm Prevention & Dynamic SQL Optimization

TOPICS

- SQL 2025 enhancements for compilation efficiency
- Parameterization best practices (sp_executesql)
- Avoiding unnecessary recompilation

13

2 Labs

Locking, Blocking & Isolation Levels

TOPICS

- SQL 2025 optimized locking model
- Lock After Qualification, Transaction ID Locking
- RCSI, Snapshot, Serializable, Repeatable Read, Read Uncommitted
- Advanced blocking chain diagnostics

DAY 4 Deadlocks, Tempdb Optimization & Resource Governance

14

Deadlocks, Extended Events & Monitoring

TOPICS

Deadlock detection and capture · Deadlock graph interpretation · Extended Events for locks, waits, deadlocks · Automation and alerting · Time-bound event sessions

15

Tempdb Performance & Governance

TOPICS

Tempdb space governance (SQL 2025) · ADR improvements · Tempdb file layout and configuration · Managing spills, sorts, and hash joins

16

2 Labs

Resource Governance & Workload Management

TOPICS

- CPU, IO, and memory governance
- Resource Governor workload groups
- Monitoring memory grants, IO stalls, and system waits

DAY 5 Monitoring, Troubleshooting & Continuous Optimization

17

Monitoring & Baseline Establishment

TOPICS

- Performance Dashboard
- DMVs for CPU, memory, IO, locks, tempdb, waits
- Extended Events for diagnostics
- Building actionable baselines

18

Troubleshooting SQL Server Performance

TOPICS

- Identifying slow queries
- Root-cause analysis of regressions
- Statistics health and lifecycle
- Index usage, missing and dormant index analysis

19

Performance Governance & Automation

TOPICS

Automated health checks · Alerts and performance reporting · QA-to-production performance validation · Using SLAs for performance governance

20

2 Labs

Continuous Optimization with SQL Server 2025

TOPICS

- IQP adoption strategy
- Rolling out optimized locking and resource governance
- Index and statistics lifecycle management
- Designing for mixed OLTP + analytics workloads
- Tips & Tricks to Improve Database Server & Query Performance

HANDS-ON LABS

Practise What You Learn

#	MODULE	ACTIVITY
02	**Waits & Queues Methodology**	Slow query diagnosis using waits and engine internals
06	**Batch Mode & Hybrid Workload Optimization**	■ Build NCCS and evaluate analytics performance ■ Run hybrid OLTP + reporting workloads; observe batch mode behavior
13	**Locking, Blocking & Isolation Levels**	■ **Mixed workload simulation:** DOP feedback, memory grants, plan cache ■ Locking and blocking analysis
16	**Resource Governance & Workload Management**	■ Concurrency simulation using optimized locking ■ Tempdb high-load stress test
20	**Continuous Optimization with SQL Server 2025**	■ Baseline creation and workload drift detection ■ Automated weekly health report generation

WHAT IS INCLUDED

Everything You Need to Succeed

- Koenig course material for every module
- Delivery by certified instructors and subject matter experts
- Hands-on exercises throughout the course
- Course completion certificate from Koenig

ABOUT KOENIG

Who We Are

Established in 1993, Koenig Solutions is a globally recognised training provider with 35+ technology partnerships, 5,000+ training programmes and a network of certified instructors and subject matter experts, supporting individuals and enterprise teams worldwide.

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