

Syllabus for August 2021 Qualifying Examination of  
**Math 5172 - Finite Element Analysis**

**References:**

- [R1] Lecture notes for Spring 2021 MATH 5172 class
- [R2] Claes Johnson: Numerical solution of PDEs by the Finite Element method, Dover 2009,
- [R3] B. Szabo and I. Babuska: Finite Element Analysis, John Wiley, 1991

**Part I All topics in Lecture notes 1-11, 13-17, and 20.**

**Part II** Chapters 1, 2, 3, 4, 8 of [R2]:

- Sections 1.1 - 1.7. Weak solution. Cauchy inequality. Sobolev norm. Finite element solution is the projection of exact solution on  $V_h$
- Sections 2.1- 2.4 Variational formulations, weak solutions, Galerkin approximation Existence of Finite Element solution.
- Sections 3.1-3.3 Constructions of finite element spaces (solution spaces).

**Part III** Chapters 6, 7 of [R3]: Shape functions on Rectangular elements (triangular elements), respectively. Construction of stiffness matrices and local load vectors by using the reference element approach. How to impose non-homogeneous essential boundary conditions. How to impose Neumann or mixed boundary conditions.

- Section 6.1 Shape functions for quadrilaterals
- Section 6.2 Shape functions for Triangles
- Section 6.3 Mapping functions
- Section 6.4 Integration Procedures
- Section 7.1 Computation of Element Stiffness Matrices
- Section 7.2 Computation of element (local) Load vectors