SH2774 Numeriska metoder inom kärnkraftsteknik 6,0 hp

Numerical Methods in Nuclear Engineering

När kurs inte längre ges har student möjlighet att examineras under ytterligare två läsår.

Fastställande

Kursplan för SH2774 gäller från och med HT08

Betygsskala

A, B, C, D, E, FX, F

Utbildningsnivå

Avancerad nivå

Huvudområden

Särskild behörighet

Recommended prerequisites: Basic courses in Calculus (Mathematical Analysis), basic course in Linear Algebra, basic knowledge of any programming language.

Undervisningsspråk

Undervisningsspråk anges i kurstillfällesinformationen i kurs- och programkatalogen.

Lärandemål

Modern engineering work requires a variety of simulation codes. However, computer simulation has become a frequently used and misused tool. Too often the numerical simulation is used as a black box with little insight into the underlying assumptions. The traditional engineering education provides no or little background in simulation techniques, their capabilities and limitations. This course is intended to provide a systematic introduction into the methods, capabilities and limitations of computer simulation.

The course focus is on computational methods for problems arising in nuclear reactor system analysis. Topics include numerical methods for solving large, sparse systems of linear equations that result from the discretization of partial differential equations, numerical solution of nonlinear algebraic equations, eigenvalue problems, ordinary differential equations (ODE's) and partial differential equations (PDE's). Applications include heat conduction, fluid mechanics, neutron diffusion and neutron kinetics.

Within the context of nuclear engineering, after the course the student should be able to:

- Solve system of linear equations
- Solve system of non-linear equations
- Solve eivenvalue/eigenvector problem
- Use Taylor expansion to derive finite difference approximation
- Derive truncation error of discretized equations
- Analyze consistency, stability and convergence of numerical method
- Solve system of linear ODE's
- Solve system of linear PDE's arising in nuclear engineering applications

Kursinnehåll

The course addresses fundamentals of numerical analysis and numerical solution of ODE's and PDE's arising in nuclear engineering. Topics covered include

- Solution of linear equations using direct, stationary and non-stationary iterative methods
- Solution of system of non-linear equations using iterative methods
- Solution of eigenvalue problems
- Numerical integration and differentiation
- Consistency, stability and convergence of discretized equations
- Truncation error analysis
- Von Neumann stability analysis
- Lax-Richtmyer equivalence theorem
- Finite difference discretization of ODE's
- Numerical solution of initial value and boundary value ODE's
- Finite difference and finite volume discretization of PDE's
- Numerical solution of PDE's arising in nuclear engineering

Kurslitteratur

“A Friendly Introduction to Numerical Analysis”, by Brian Bradie, Prentice Hall.

Examination

- INL1 - Inlämningsuppgift, 1,0 hp, betygsskala: P, F
- INL2 - Inlämningsuppgift, 1,0 hp, betygsskala: P, F
- INL3 - Inlämningsuppgift, 1,0 hp, betygsskala: P, F
- INL4 - Inlämningsuppgift, 1,0 hp, betygsskala: P, F
- TEN1 - Tentamen, 1,0 hp, betygsskala: A, B, C, D, E, FX, F
- TEN2 - Tentamen, 1,0 hp, betygsskala: A, B, C, D, E, FX, F

Examinator beslutar, baserat på rekommendation från KTH:s handläggare av stöd till studenter med funktionsnedsättning, om eventuell anpassad examination för studenter med dokumenterad, varaktig funktionsnedsättning.

Examinator får medge annan examinationsform vid omexamination av enstaka studenter.

Homework assignments (INL1-4, 4 ECTS).
Two written exams (TEN1-2, 2 ECTS).

Etiskt förhållningssätt

- Vid grupparbete har alla i gruppen ansvar för gruppens arbete.
- Vid examination ska varje student ärligt redovisa hjälp som erhållits och källor som använts.
- Vid muntlig examination ska varje student kunna redogöra för hela uppgiften och hela lösningen.