

NERS 554

Radiation Shielding Design

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Requirements:

- Personal laptop (can be shared if needed); MCNP5 and MCNP-X RSICC licenses (please request them ASAP at <http://www-rsicc.ornl.gov/> – MCNP 4C – already available to students – will be used as backup); Matlab access
- Class attendance is mandatory

Text books and study materials:

1. J. Kenneth Shultis and Richard E. Faw, Radiation Shielding
2. MCNP5 and MCNP-X manuals
3. Course handouts and notes

<u>Grading:</u>	10 % midterm project presentation
	10% midterm project report
	30% midterm exam
	20 % final project presentation
	30 % final project report

Format:

Weekly

- Lectures, 1.5 hours per week (Monday 9.30-11.00)
- Project laboratories, 1.5 hours per week (Wednesday 9.30-11.00)
- Group meetings, 1 hour per week (Friday 9.30-10.30)

Syllabus (Lectures are shown in bold)

Week 1

Introduction to Monte Carlo simulations

- Probability density functions
- Random sampling

Introduction to MCNP5 and MCNP-X (Part 1)

- Building geometries with MCNP
- Defining the source

Introduction to Project

- Break class into groups
- Discuss possible project topics

Week 2

Introduction to MCNP5 and MCNP-X (Part 2)

- Defining and using tallies

Week 3

Introduction to shielding problems

- Typical radioactive sources
- Neutron and gamma-ray shielding
- Charged particles
- Applications

Introduction to MCNP5 and MCNP-X (Part 3)

- Variance reduction techniques
- Macroscopic cross sections

Week 4

Introduction to MCNP-PoliMi

- **Neutron interactions with matter**
- **Adjustments for MCNP-PoliMi**
- **Uses of MCNP-PoliMi**

MCNP Dose Calculations

- **Dose equivalent**
- **Estimating doses in MCNP**
- **Flux-to-dose conversions**

Week 5

Midterm project proposal presentations

Week 6

Photon and Neutron Response Functions

- **Dose**
- **Mean free path**
- **Buildup factors**

Weekly project updates

Week 7

Detector Response

- **Types of detectors and their uses**
- **Response functions of detectors**
- **Buildup factors**

Weekly project updates

Midterm report due

Week 8

Basic Dose Calculations

- **Uncollided flux and dose with and without shielding**

Weekly project updates

Week 9

Special Techniques for Photon Dose Calculations

- **Total dose calculations for shielded photon sources**
- **Buildup factors**

Weekly project updates

Week 10

Special Techniques for Neutron Dose Calculations

- **Differences between photon and neutron shielding**
- **Removal Coefficients**

Weekly project updates

Week 11

Exam Review

*Midterm exam (in class)

Participate in American Nuclear Society competition
Publish best project in conference proceedings/journal