



ETI 101 Syllabus

Fundamentals of Nuclear Science and Engineering for Nonproliferation

Objective

The course objective is to engage the ETI academic community and introduce foundations of nuclear science and engineering as they apply to non proliferation problems.

Delivery

Online, synchronous and asynchronous

Schedule

Online meetings - T/Th 12:00 - 13:20, weekly

Live Lecture Access

<https://bluejeans.com/463030392>

Phone Dial-in: +1.408.419.1715 (United States(San Jose))

Meeting ID: 463 030 392

Module 1 - Nuclear science of radiation interactions and applications

Module lead: R. Cao

Lecturers: S. Biegalski, P. Tsvetkov, R. Cao, M. Short

4 weeks, 8 lectures (January 12 - February 4)

Jan 11 Jan 13	11:10 - 12:20 11:10 - 12:20	<ul style="list-style-type: none">• Energy and units, fundamental physics background, special relativity.• Atoms and nuclei, nuclear structure and data files, relative stability and energy conservation.• Radioactivity, nuclear stability, radioactive decay, decay chains.	Steven Biegalski, Georgia Tech.
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Jan 18 Jan 20	11:10 - 12:30 11:10 - 12:30	<ul style="list-style-type: none"> • Neutron interactions, neutron reactions and neutron cross sections • Nuclear processes, nuclear reactions, transmutation, conservation principles, reaction rates, particle attenuation. • Nuclear data and evaluated nuclear data files. • Fission, process, energy considerations, energy from nuclear fuels. 	Pavel Tsvetkov, Texas A&M
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Jan 25 Jan 27	11:10 - 12:30 11:10 - 12:30	<ul style="list-style-type: none"> • Ions, electrons and neutrons interaction with matter and detection. • Gamma interactions with matter and detection. 	Raymond Cao, Ohio State
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Feb 1 Feb 3	11:10 - 12:30 11:10 - 12:30 (https://zoom.us/j/4074134486)	<ul style="list-style-type: none"> • Materials Science 101 - The very basics and mechanical properties for nuclear engineers • Radiation effects and damage on nuclear materials for reactors and forensics 	Michael Short, MIT
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Module 2 - Nuclear engineering of reactors and systems

Module lead: Pavel Tsvetkov (TAMU)

Lecturers: Pavel Tsvetkov (TAMU), Mike Short (MIT)

4 weeks, 8 lectures (February 9 - March 4)

Feb 9 Feb 11	12:00 - 13:20 12:00 - 13:20	<ul style="list-style-type: none"> • How do nuclear reactors work? • Energy conversion – Applications 	Pavel Tsvetkov, Texas A&M
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Feb 16 Feb 18	12:00 - 13:20 12:00 - 13:20	<ul style="list-style-type: none"> • Nuclear power plant – heat generation, removal, plant components and operational aspects • Reactor types and applications 	Pavel Tsvetkov, Texas A&M
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Feb 23 Feb 25	12:00 - 13:20 13:00 - 14:20	<ul style="list-style-type: none"> • Nuclear safety, security and safeguards • Decommissioning 	Pavel Tsvetkov, Texas A&M
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Mar 2 Mar 4	12:00 - 13:20 12:00 - 13:20	<ul style="list-style-type: none"> • Fusion energy and plasmas • Externally-driven fission systems 	Anne White, MIT Pavel Tsvetkov, Texas A&M
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Module 3 - Nuclear fuel cycle and waste management

Module lead: Paul Wilson (U. Wisconsin)

Lecturers: Paul Wilson,

Potential Lecturers: Andrew Worrall (ORNL), Jen Shafer

4 weeks, 8 lectures (March 9 - April 1)

Mar 9 Mar 11	11:00 - 12:30 11:00 - 12:30 (https://uwmadison.zoom.us/j/96490985478)	<ul style="list-style-type: none"> • Overview of fuel cycle • U resources, Mining & Milling 	Paul Wilson, U. Wisconsin P. Brown (UW)
Mar 16 Mar 18	11:00 - 12:30 11:00 - 12:30 (https://uwmadison.zoom.us/j/96490985478)	<ul style="list-style-type: none"> • Enrichment Technology • In-core fuel management & Burnup 	P. Wilson P. Wilson



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Mar 23 Mar 25	11:00 - 12:30 11:00 - 12:30 (https://uwma.dison.zoom.us/j/96490985478)	<ul style="list-style-type: none"> Fuel forms (oxide, metal, triso, etc) Partitioning & Transmutation Technology 	M. Meyer (INL) Jen Shafer (Mines)
Mar 30 Apr 1	11:00 - 12:30 11:00 - 12:30 (https://uwma.dison.zoom.us/j/96490985478)	<ul style="list-style-type: none"> Waste Classification & Management Fuel Cycle Comparisons (incl. Th) 	P. Wilson Andrew Worrall

Module 4 - Overview of nuclear security and nonproliferation

Module lead: Robert Brigantic (PNNL)

Lecturers: S. Biegalski, B. Wilson, R. Goldston, S. Chirayath, M. Schanfein, G. Reyes, M. Short, D. Haas, E. Brubaker, K. Koehler, J. Stinnett, A. Lousteau

5 weeks, 10 lectures (April 6 - May 6)

Apr 6	12:00 - 13:20	<ul style="list-style-type: none"> National and International Laws and Organizations Supporting Nuclear Security and Nonproliferation 	Steven Biegalski
Apr 8	12:00 - 13:20	<ul style="list-style-type: none"> An Inspector's view of IAEA Safeguards 	Ben Wilson
Apr 13	12:00 - 13:20	<ul style="list-style-type: none"> The Role of Verification in Arms Control and Nonproliferation Treaties 	Rob Goldston
Apr 15	12:00 - 13:20 https://tamu.zoom.us/j/95564056409?pwd=cGN0OVVvNlN6TC9reUkxZlNkSkJhUT09 Meeting ID: 955 6405 6409	<ul style="list-style-type: none"> Fundamentals of Nuclear Material Accountancy 	Sunil Chirayath



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Apr 20	12:00 - 13:20	<ul style="list-style-type: none">• IAEA Facility Specific Safeguards Implementation• Stored Energy Fingerprints for Non-Proliferation Treaty Verification	Mark Schanfein and Gus Reyes
Apr 22	12:00 - 13:20		Michael Short
Apr 27	12:00 - 13:20	<ul style="list-style-type: none">• Nuclear Explosion Monitoring• Radiation Imaging and its Applications in Nuclear Non-Proliferation	Derek Haas
Apr 29	12:00 - 13:20		Erik Brubaker
May 4	12:00 - 13:20	<ul style="list-style-type: none">• Destructive and Non-destructive Assay Techniques• Radiation Detection Systems for Safeguards and Security Applications	Katrina Koehler and Jacob Stinnett
May 6	12:00 - 13:20		Angie Lousteau