

Center of Excellence in Explosives Detection, Mitigation and Response

THE
UNIVERSITY
OF RHODE ISLAND

Professional Level Courses

Contact Information
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BASIC COURSES

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| 1 | Fundamentals of Explosives | 3 | 2 | Basic Definitions and Principles
Chemistry - Conventional Explosives
Chemistry - Unconventional Explosives
Explosive Safety
Shock-wave Physics
Detonation Physics: theory & phenomena
Initiation of Detonation: initiation criteria, hot spots, shock, DDT
Explosive Devices and Applications
Explosive Effects |
| 2 | Explosive Operations:
Regulations & Protocols | 2 | 1 | A walk through the safety manuals
Commercial Storage Regulations: BATF & NFPA 495
Federal Regulations Relevant to Government Agencies
personnel protection, training & certification, mishap reporting, SOP prep.
Required testing (ESD, shock friction, impact, thermal) & what it means
Specifics of Handling Explosives (individually discussed)
History of explosive accidents |

ENERGETIC MATERIAL BEHAVIOR AND PERFORMANCE

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| 3 | Stability, Compatibility &
Surveillance | 2 | 1 | Thermal safety--first steps to full-up systems-tests, use of results, precautions
Complete analysis of thermal stability & compatibility
Surveillance issues
Cook-off - thermal explosion models |
| 4 | Propellants & Combustion | 2 | 1 | Combustion of energetics: Theory & Experiments
Flame spread and convective burning
Flame spread in cracks
Surface ignition (laser)
Propulsion equations |

5	Detonation Theory and DDT Modeling	3	3	Detonation models and phenomenology Detonation theory: mathematics and thermodynamics Detonation Shock Dynamics Deflagration-to-detonation (DDT) phenomenology & testing DDT: Theory & modeling
6	Explosive Systems Hazards & Insensitive Munitions	3	3	Fundamentals of explosives behavior related to hazards Deflagration-to-detonation (DDT) phenomenology & testing Characterization of & flame spread in damaged explosives Ignition sources: mechanical, electrical, fragment impact Insensitive munition policy and test requirements Design techniques to reduce violence of responses to accidents Insensitive high explosives (IHEs)

EXPLOSIVES APPLICATIONS AND EFFECTS

7	Dynamic Diagnostics	2	2	Simple & complex measurements TECHNIQUES: witness plates, make switches, detonation waveshaping, gas guns, piezo pressure gauges, multiple embedded gauges, ultrahigh-speed framing & streak cameras, multiple embedded gauges, interferometry, pulsed radiography APPLICATIONS: device performance, wave arrival times, pressure histories in solids and air, HE output, shock wave evolution for use with hydro codes, detonation spreading, shock-wave shapes within solids
8	Structural Response to Blast	2	2	Blast wave from high explosives - scaling laws Coupling to structures Stress & strain, single-degree-of-freedom systems Pressure-impulse failure estimates Gaseous combustion and detonation Example: TWA 800 explosion
9	Material Response under Impulsive Loading	2	3	Detonation wave as a driver; shock interactions Material structure and mechanical behavior Material response under impulsive loading - experiments Inelastic continuum mechanics & material damage Material response modeling and wavecodes
10	Explosive Devices & Train Design	2	2	Low-energy electroexplosive and laser-ignited devices High-power detonators and arrays, includes slapper detonator (ESAD) technology Explosive train design and statistical reliability testing Hazards with explosive devices and trains Manufacturing explosive devices
11	Warhead Mechanics	3	3	Explosive output - concepts, Gurney model Detonation wave interactions and effects on metal Shaped charges and jet penetration Fuzes, esp. in-line electronic safing, arming & firing (ESADs)

12	Pyrotechnics	3	3	General principles and chemistry of pyrotechnics Roles for pyrotechnics: heat, ignition, light, thrust producers Pyrotechnic devices Flares & luminosity Manufacturing, incl. twin-screw extrusion Combustion propagation in pyrotechnics Thermites & metastable interstitial compositions (MIC)
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SPECIALIST COURSES

13	Terrorism Issues	2	2	Terrorist Threats: Peroxide Explosives-preparation, performance & safety Pre-blast / Detection of Explosives Fragment hazards Performance codes by law enforcement Case Studies
14	Environmental Issues with Explosives	3	3	This can serve as a stand-alone course for environmental folks or an indepth look at health and environmental impact of explosives General explosive issues and toxicity Explosive residue from blast Fate & transport of explosives in soil, water, plants Sampling protocols & analytical methods
15	Laboratory Analysis & Forensics	2	2	Review of actual protocols for explosive analysis (by specific explosive) Operational safety Case studies from former forensic scientists
16	Material Characterization & Processing	3	3	Characterization & effects of particle morphology Controlling particle morphology - recrystallization Formulation Laboratory and processing safety
17	Chemistry as Applied to Explosives for Non-chemists	3	1	Fundamentals: from basic nomenclature to reading chemical equations to recognizing explosives
18	Chemistry as Applied to Explosives for the Experts	2	2	Synthesis of common military explosives New materials and preparations Advanced and high-nitrogen energetic materials