

**FY22-24 EDUCATIONAL SKILLS REQUIREMENTS (ESRs)**  
**Applied Physics of Combat Systems**  
**Subspecialty Code 57XX**  
**Curriculum 533**

1. Curriculum Number: 533
2. Curriculum taught at NPS.
3. Curriculum Length in months: 24 months
4. APC Required: 323
5. Community Managers have agreed to allow billets to be coded for Applied Physics for Combat Systems (533) and officers to be educated for this curriculum.

<u>Designator</u>	<u>Officer Community Manager</u>
a. 1110	Surface
b. 1120	Submarine
c. 1130	Special Warfare
d. 1140	EOD
e. 1300	Aviation
f. 1440	Engineering Duty

6. The officer must understand the fundamental concepts and be familiar with the basic functional areas of Combat Systems within the Department of the Navy (DON) and the DoD including:

**ESR-1: MATHEMATICS, SCIENCE, AND ENGINEERING FUNDAMENTALS:** A solid foundation in the mathematics, physics, and engineering which underpin combat-system technologies. A basis to support the theoretical and experimental aspects of the more advanced courses in the curriculum.

**ESR-2: SENSORS:** A graduate level understanding of energy propagation (acoustic and electromagnetic), and the physics of solid state, electro-optic, and quantum sensing devices. Including knowledge of radar and sonar system principles, signal analysis, and signal processing.

**ESR-3: COMBAT SYSTEMS CONTROL:** An understanding of the principles of design, integration, testing and evaluation of system elements necessary to complete the detect to engage sequence and integrate multiple combat systems, communication system technologies, their elements, and operational forces in advanced combat systems.

Enclosure (3)

Enclosure (2)

**ESR-4: WEAPONS SYSTEMS:** A graduate-level understanding of the physics governing weapon effects including, fluid dynamics of subsonic, supersonic, and hypersonic objects; directed energy weapons; missiles and projectiles; and warheads and their effects.

**ESR-5: COMBAT SYSTEMS ENGINEERING, ANALYSIS, SIMULATION, AND TESTING:** A foundation in system analysis and simulation, the limits of each, and their effect on combat systems testing.

**ESR-6: MATERIALS SCIENCE:** A familiarity with the concepts of materials science sufficient to understand the mechanical, electrical, and thermal properties of materials important in present and future combat systems including exposure to the applicability of materials in combat system applications, and production techniques.

**ESR-7: CYBER:** Understand and apply the fundamentals of the underlying principles of cyber infrastructure and systems; inherent vulnerabilities and threats, including industrial control systems; and defensive security procedures. (\* ESR Required for 14XX designators only.)

**ESR-8: TECHNICAL SPECIALIZATION:** Each officer will also acquire technical competence in one or more of the following areas as it pertains to Combat Systems: ELECTROMAGNETIC SYSTEMS, WEAPONS & EFFECTS, PHYSICS, UNDERWATER ACOUSTIC SYSTEMS, OR A SPECIFIC ENGINEERING DISCIPLINE.

The knowledge required for an approved concentration is:

a. ELECTROMAGNETIC SYSTEMS (5701)

(1) Propagation and scattering of optical, IR, and microwave radiation in the turbulent atmosphere as they influence target detection.

(2) Advanced sensor and detection techniques for military applications.

(3) Advanced concepts of target surveillance, acquisition, and engagement.

Enclosure (3)

Enclosure (2)

b. WEAPONS & EFFECTS (5702)

(1) Molecular energetics and detonation physics.

(2) Impact phenomena. Kinetic, fragmentation, and rod-like projectile penetration.

(3) Warhead design and lethality considerations; target vulnerability and survivability consideration; kill probability.

(4) Principles of directed energy weapons systems and their effects.

(5) Electric ship weapon systems.

c. PHYSICS (5703)

(1) Statistical physics.

(2) Advanced E&M radiation.

(3) Advanced Quantum Mechanics.

d. UNDERWATER ACOUSTIC SYSTEMS (5704)

(1) Wave propagation in the ocean; scattering, fluctuations and boundary interactions as they affect detection, localization, and prosecution of underwater targets; underwater transducer design and array theory.

(2) Active and passive acoustic signal processing for detection of submarines, mines, and other underwater weapons; adaptive techniques.

(3) Acoustic influences of oceanographic phenomena, which affect target detection including boundary characteristics, ambient noise, sound speed profiles, fronts, and eddies.

e. TOTAL SHIP SYSTEMS ENGINEERING (5705)

(1) Power systems.

(2) Naval architecture and ship design.

(3) Shipboard combat systems.

Enclosure (3)

Enclosure (2)

(4) Integration issues.

**ESR-9: THESIS:** The graduate will demonstrate the ability to conduct independent research in combat systems sciences and engineering, and proficiency in presenting the results in writing and orally by means of a thesis and command oriented briefing.

APPROVED: OKANO.ELIZABETH.SEI. Digitally signed by  
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Curriculum Sponsor, PEO IWS [DATE]

APPROVED:  07Aug2024  
Director, OPNAV N71 [DATE]

Enclosure (3)

Enclosure (2)