Proposed Educational Skill Requirements
Space Systems Operations
Subspecialty 6206
Curriculum 366

1. Curriculum Number: 366

2. Curriculum taught at Naval Postgraduate School

3. Curriculum Length in Months: 21

4. APC Required: 334

5. The officer must understand the fundamental concepts and be familiar with the basic functional areas of Space Systems Operations within the Department of the Navy (DON) and the Department of Defense (DOD) including the following numbered ESRs:

ESR-1. Orbital Mechanics and Space Environment:

a. Graduates will examine the basic physics of orbital motion, and calculate and distinguish the parameters used in the description of orbits and their ground tracks.

b. Graduates will examine the design of orbits and constellations, and analyze how they are achieved, maintained, and controlled; to include spacecraft maneuver and orbit transfer calculations.

c. Graduates will examine the fundamentals of spacecraft tracking and command/control from a ground station.

d. Graduates will analyze the relationship between various orbital characteristics and the satisfaction of mission requirements, including the advantages and disadvantages of various orbits.

e. Graduates examine the space environment impacts on spacecraft parts, materials, and operations to spacecraft and mission design.

ESR-2. Spacecraft Design:

a. Graduates will examine the basic system design of a spacecraft including its various subsystems: propulsion; structure; thermal; attitude determination and control; electrical power; and telemetry, tracking and commanding.

b. Graduates will assess key interactions between the various subsystems and their effects on system performance.

ESR-3. National Security Systems:

a. Graduates will examine the nature of space warfare (theory, history, doctrine, and policy); distinguish how space operations as discussed in JP 3-14 enable joint force capabilities; and interpret how current and planned space capabilities contribute to the satisfaction of mission objectives.

b. Graduates will examine the roles, responsibilities, and relationships of National and DoD organizations in establishing policies, priorities, and requirements for National Security Space systems; and in the design, acquisition, operation, and exploitation of these systems.

c. Graduates will examine the role of the Services / Agencies in establishing required space system capabilities, and will translate these capabilities into system performance requirements.

d. Graduates will examine: current and planned Intelligence, Surveillance, and Reconnaissance (ISR) capabilities; how space systems contribute to these capabilities; the intelligence collection and analysis process; and how war-fighters access information from these sources.

e. Graduates will develop concepts of employment and assess space tactics and CONOPS. The development and assessment shall consider end-to-end capabilities and system-of-systems architectures that enhance, support, and integrate into military operations to include resiliency concepts in a contested environment.

f. Graduates will identify how proposed space-related capabilities and doctrine transition from concept to real-world implementation.

g. Graduates will examine the capabilities of DoD, other government, and commercial space systems, and how those systems relate to National Space Systems to include potential overlaps and leverage opportunities.

ESR-4. Management/Acquisition:

a. Graduates will examine project management and DoD system acquisition methods and procedures to include contract management, financial management and control, and the Planning, Programming, Budgeting and Execution system (PPBE).

b. Graduates will examine system acquisition organizational responsibilities and relationships (e.g., Congress, DoD, Services, Resource Sponsor, Systems Commands, Operating Forces) as they pertain to the acquisition of systems for DoD, Naval, and civilian agency users.

c. Graduates will examine the unique nature of space acquisition programs using the Space Systems Acquisition Policy process. Based on this knowledge, they will plan and structure a notional space system acquisition program.

d. Graduates will examine how proposed space-related capabilities and DOTMLPF requirements are translated from concept to real-world implementation.

e. Graduates will apply the tools of project management (e.g., scheduling, costing, budgeting, planning, resource negotiation, risk management) to a space project.

f. Graduates will prepare for and conduct program reviews, from systems requirements through critical design, during spacecraft and architecture design projects.

ESR-5. Communications:

a. Graduates will examine the basic principles of networks and communications systems operations and engineering to include both the space and ground segments.

b. Graduates will examine digital and analog communications architecture and networks design, including such topics as frequency reuse, multiple access, link design, repeater architecture, source encoding, waveforms/modulations, and propagation media.

c. Graduates will calculate and analyze link budgets to assess communication system suitability to support mission requirements, and to translate mission requirements into communications system design characteristics.

d. Graduates will differentiate, compare, and contrast the characteristics and capabilities of current and future space related networks and communications systems in use or planned by Naval operating and Joint forces afloat and ashore and understand the threats (both kinetic and non-kinetic) to these capabilities and associated countering or mitigation strategies.

e. Graduates will recognize the national and international issues involving use of the frequency spectrum and the relative priority and criticality of various segments of the frequency spectrum, and the space systems that employ them, to national defense.

f. Graduates will discuss the nature of the rapid evolution in commercial satellite communications systems, and recognize the impact of such advancements on military operations and systems development.

ESR-6. Remote Sensing:

a. Graduates will examine principles of active and passive sensors in current or planned use.

b. Graduates will examine the effects of the space, atmospheric, and terrestrial environments (including countermeasures) on sensor performance.

c. Graduates will examine tradeoffs among various sensors and platforms, evaluating how each satisfies mission requirements such as access area, resolution, timeliness, and capacity.

ESR-7. Analysis and Evaluation:

a. Graduates will derive, assess, and articulate capabilities necessary for the use of National Security Space systems in support of military operations.

b. Graduates will examine various engineering and mathematical definitions of cost functions (revisit time, dwell time, local coverage, etc.)

c. Graduates will use business case (economic) and performance data to analyze trade-offs between commercial and DoD systems to provide desired operational capabilities.

d. Graduates will understand and apply the development and applicability of models and simulations, with a focus on specific space applications. Graduates will apply these concepts through space architecture simulation, system performance evaluation, and alternative solution analysis.

e. Graduates will analyze and evaluate system characteristics to satisfy required capabilities in a cost-effective manner using modeling and simulation, field and laboratory experiments, and/or other quantitative and qualitative methods.

ESR-8. Architecting Missions:

a. Graduates will examine and relate the principles of architecting a complex, Joint National Security Space mission, and the life cycle process by which a space system is conceived, structured, designed, built, tested, certified and operated in a way that ensures its integrity and performance.

b. Graduates will develop and assess system requirements; compose alternate architectures to satisfy those requirements; and evaluate and select the most effective alternative.

c. Graduates will develop system design criteria from stated performance requirements, and conduct trade-offs between payloads and other spacecraft subsystems.

d. Graduates will examine the design of current and planned space-based mission payloads (e.g., ISR, Communications, PNT, SIGINT).

e. Graduates will examine the basic principles and operational issues of space access to include launch vehicle performance, launch windows, and their impact on military operations.

ESR-9. Information Warfare Fundamentals:

a. Graduates will analyze military operations in the information environment with respect to assured information delivery, availability, and protection, with an awareness of attack and exploitation capabilities, and mitigation strategies.

b. Graduates will understand multi-domain concepts and operational framework in order to analyze the structure of organizational sub-components.

c. Graduates will understand the relationship between space operations and operations in the information environment.

d. Graduates will examine the role of Space Operations in the context of Multi-Domain Operations and the relationship between Space Operations, Cyberspace Operations, and Electromagnetic Spectrum Operations with emphasis on support during the periods of competition and armed conflict.

ESR-10. Operational Mission Planning:

a. Graduates will examine the basic elements of mission operations – spacecraft commanding, payload management, anomaly resolution, orbital maneuver planning – and will apply these concepts during satellite and architecture design projects.

b. Graduates will understand the role of space in the development of an OPLAN. Graduates will have the ability to assess space operations and associated capabilities as identified in JP 3-14. Graduates will demonstrate the ability to develop an acceptable command and control structure for space operations and the space annex of an OPLAN.

c. Graduates will develop space plans in support of global campaign plans and/or OPORDS to include staff estimates, ANNEX inputs and command recommendations for space based capabilities, limited Space Control, threat analysis and mitigation measures, and limiting factors culminating in a mission planning exercise

d. Graduates will gain exposure to appropriate space planning and analysis tools and capabilities that exist within the DoD/Intel Communities and use them in execution of mission planning exercise.

ESR-11. Advanced Concepts and Technology:

a. Graduates will examine how current and future space systems contribute to National Security and will examine means to employ space-based capabilities to support information dominance.

b. Graduates will examine potential future military space requirements stemming from desired information dominance capabilities.

c. Graduates will examine future concepts of operation published by various DoD and international organizations (ESA, ISA, WSO, etc.) based on emerging technologies and appraise their impact on military space.

d. Graduates will examine the advanced concepts and technologies which could be used in future military space systems.

ESR-12. Space National Policy:

a. Graduates will analyze the space acquisition environment to develop an understanding of its impact on the delivery of space capabilities and national security.

b. Graduates will analyze the space-related policy and strategy environment to ascertain its influence on US national security.

c. Graduates will synthesize approaches to effectively advocate for space capabilities.

d. Graduates will synthesize approaches to effectively employ space capabilities in support of national leadership and joint/coalition forces.

ESR-13. Research:

a. Graduates will conduct independent or group research on a space systems problem, including resolution of the problem and presentation of the results and analysis in both written and oral form.

6. Major Area Sponsor, Subspecialty Code/Curriculum Sponsor and Subject Matter Experts:

a. Subspecialty Code/Curriculum Sponsor: VADM Timothy White, Commander, U.S. Fleet Cyber Command/Commander, U.S. TENTH Fleet

b. Major Area Sponsor: VADM Matthew Kohler, OPNAV N2N6.

c. Subject Matter Experts: Dr. Clifton Phillips, Engineering APEO, PEO-Space Systems; CAPT James Mills, Chief of Staff, U.S. Fleet Cyber Command.

d. Curriculum Sponsor Action Officer SME: Mr. William Lovejoy, Deputy Director of Education and Training, U.S. Fleet Cyber Command.

APPROVED: _____ 10 Aug 18
FLTCM YEE RCA M/C10F (Curriculum Sponsor) [DATE]

APPROVED: _____ 27 AUG 18
OPNAV N2N6 (Major Area Sponsor) [DATE]

APPROVED: _____ SEP 26 2018
President, NPS [DATE]

APPROVED: _____ 5 November 2018
Director, OPNAV N12 [DATE]