2024-26 EDUCATIONAL SKILL REQUIREMENTS
FOR RESIDENT CURRICULUM 580
SYSTEMS ENGINEERING - 5801P, 5802P, 5804P

1. Curriculum Number: 580

2. Curriculum taught by NPS resident and non-resident. Resident and non-resident active duty Navy and Marine Corps students are fully funded.

3. Curriculum Length in Months: 21
Month the program starts:

September or March
Refresher quarter: July or January

4. APC Required 234

5. Officers entering into the Systems Engineering curriculum will be offered the necessary preparatory level courses to enable them to satisfy the equivalent of a baccalaureate degree in Engineering. By the time they complete the curriculum, they shall meet, as a minimum, the requirements set forth by the Accreditation Board for Engineering and Technology (ABET). In the context of systems engineering, the term "systems" shall be used to include both systems and systems-of-systems (SoS). At the graduate level, the officer will acquire the competence to effectively contribute as a systems engineer to naval systems research, design, development, maintenance and acquisition. The officer will gain the ability to effectively integrate future technological, engineering, and acquisition approaches with existing practice through a combination of core systems engineering courses, specialization studies, and project/thesis research. An officer will meet the below-listed ESRs through the completion of a program of study determined by the officer, the program officer and the academic associate. Individual programs and how they support the officer's attainment of the ESRs will be specifically designed to meet the needs of the Navy and the officer's interests.

a. ESR1. [UNDERGRADUATE MATHEMATICS AND BASIC SCIENCES] Understand and apply baccalaureate-equivalent coding, mathematics and physics. For mathematics, this includes single and multi-variable differential and integral calculus, ordinary differential equations, probability, and statistics. Coding includes the logic and application of programming languages. This ESR can be met by the appropriate undergraduate work.

b. ESR2. [CAPABILITY ENGINEERING] Model and analyze military operations in order to identify capability needs and derive system requirements. Use modeling and simulation to analyze the operational effectiveness and performance of existing systems, emerging technological concepts, and planned systems. Consider the joint warfighter environment, technology readiness levels, effectiveness, cost, and risk in the analysis. Select the appropriate modeling tools to include back-of-the-envelope spreadsheet modeling, analytical modeling, discrete-event simulation, and continuous simulation modeling. Analyze cost and perform suitability analysis considering the entire life cycle.

d. ESR3. [SYSTEM ARCHITECTING] Perform system architecting, applying and integrating methods for both software and hardware applications. Construct feasible system functional and physical architectures that represent a balanced approach to meeting stakeholder needs and expectations; stated, implied, and derived system requirements; cyber-resiliency objectives; and suitability objectives such as being open, modular, extensible, maintainable, and reusable. Understand system architecture frameworks and their role in architecture development. Use model-based systems engineering techniques to create, define, and develop system architectures. Develop, analyze, and compare alternative architectures against appropriate, system-level evaluation criteria.

e. ESR4. [ENGINEERING DESIGN ANALYSIS] Understand and apply core qualitative and quantitative methods to analyze and select hardware and software system designs. Methods should include problem formulation, alternatives development, alternatives modeling and evaluation, alternatives comparison, optimization, decision analysis, failure analysis, risk analysis, and futures analysis.

f. ESR5. [SYSTEM INTEGRATION AND DEVELOPMENT] Apply the core skills of system integration and development to include integrating relevant technological disciplines that bear on the system effectiveness and cost. Understand system realization methods and processes necessary to transition from design to production, including prototyping, design for producibility, and production methods.

g. ESR6. [SYSTEM VERIFICATION & VALIDATION] Apply the fundamental verification and validation principles of system test and evaluation to confirm if the capability needs and system requirements are met by the designed system. V&V principles are to include inferential statistics methods such as design of experiments (DOE) and analysis of variance (ANOVA), and testing methods such as functional simulation, analysis, examination, software in the loop, hardware in the loop, full system testing, and operational testing; in order to verify that the hardware matches the simulations in the earliest available environment and continuing during the entire life-cycle.

h. ESR7. [HUMAN SYSTEMS INTEGRATION] Address human factors during requirements definition, as well as workload, safety, training, operability and ergonomics during design. Conduct functional analysis and allocation to human elements, performing cost-risk-effectiveness trade-offs among hardware, software, and human elements. Evaluate proposed designs for man-machine integration, human performance testing, and usability during development test and evaluation. Understand basic human biology as applied to human systems.

i. ESR8. [SYSTEM DESIGN] Understand and demonstrate the system design process in a holistic context, applying and integrating methods for both software and hardware aspects of a design. The end-to-end design process should include: identifying capability need; defining requirements; conducting functional analysis and allocation to hardware, software, and human elements; creating a system functional design; designing a system; deriving and defining requirement specifications; allocating requirement specifications to sub-systems (for hardware, software, and human elements); designing for suitability, including reliability, availability, maintainability, operability, and logistical supportability; performing a system assessment by

conducting trade-off studies, evaluating system design alternatives against system capability need expressed as military effectiveness; estimating and analyzing the system cost and risk, including risk mitigation strategies; integrating human elements into the system design; and analyzing and planning for system testing and evaluation.

j. ESR9. [PROJECT MANAGEMENT] Work as a team member or leader on a military systems engineering project. Demonstrate an understanding of project management principles. Demonstrate competence in the planning and management of complex projects. Understand the principles of and apply current industry approaches and technology to manage systems design, integration, test, and evaluation for large engineering projects.

k. ESR10. [SPECIALIZATION] Demonstrate in-depth understanding of the principles, technologies, and systems used in at least one major specialty area. These areas can be specific warfare areas, such as combat systems, total ship systems, EW, IW, avionics, undersea warfare, or net-centric systems, a single traditional engineering specialty, such as mechanical, electrical, software, aerospace engineering, or naval architecture, or specialized disciplines such as human factors, availability, or safety. Demonstrate in-depth understanding of the scientific and engineering principles of the respective specialty, such as sensors, weapons, C4I systems, information systems, ship structures, hydrodynamics, power systems, and reliability. Demonstrate broad understanding of systems context of the specialization. Apply that understanding to the design of system components, sub-systems, and interfaces in the holistic context of the engineering of systems.

There will be three tracks of specialization resulting in differing P – Codes:

1. 5801 - Total Ship Systems Design Specialization
2. 5802 - Combat Systems specialization
3. 5804 - Naval Air Systems Specialization

l. ESR11*. [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)

m. ESR12. [THESIS] Conduct independent analysis and research in the area of Systems Engineering, and show proficiency in presenting the results in writing and orally by means of a thesis and command-oriented briefing appropriate to this curriculum.

Approved:

Curriculum Sponsor
Director Strategic Systems Program

7/31/2024
Date

Director, OPNAV N71

07Aug2024
Date

Enclosure (3)