$$F(\omega)=\int_{-\infty}^{\infty} f(t)e^{-j\omega_c t}dt$$

$$\overline{\Delta x} = \frac{1}{N}\sum_{i=1}^{N}\Delta x_i$$

$$R_{LO} = \left[\frac{(J_{ac}\tau_a - J_b)A_{ac}}{NEI \cdot \xi_{min}}\right]$$

$$\frac{J}{S} \propto \kappa R^2$$

ELECTRONIC WARFARE

TEST AND EVALUATION UNIVERSITY

Ipsa Scientia Potestas Est

$$\vec{a}_c = NV_c\{\dot{\vec{\sigma}}_{LOS} \times \hat{e}_R\}$$

$$\Delta S/N_{dB} = 40log_{10}\left(\frac{Rmax_1}{Rmax_0}\right)$$

KNOWLEDGE IS POWER

Electronic Warfare
Test and Evaluation University

Electronic Warfare
Specialized Technical Training Services

EX LUCE AD UMBRAS

771st TEST SQUADRON
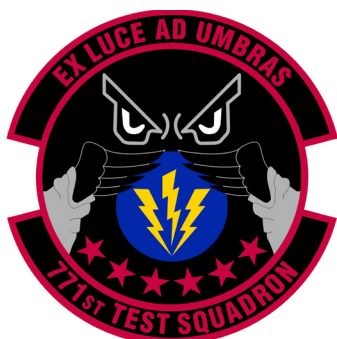
Program Information
and Course List

Courses in:
Electronic Warfare Fundamentals
Systems Under Test and Survivability
Threat Systems and Air Defense Principles

THE ELECTRONIC WARFARE TEST AND EVALUATION UNIVERSITY

The Electronic Warfare Test and Evaluation University (EW T&E U) is part of the 412th Electronic Warfare Group (EWG) at Edwards Air Force Base, California.

The EW T&E U provides an integrated set of training resources, test planning and analysis procedures, and knowledge bases to accelerate the proficiency of EW T&E engineers, who range from recent college graduates to experienced engineers, and enables them to achieve a high level of performance excellence.

THE SPECIALIZED TECHNICAL TRAINING SERVICES PROGRAM

Under the Specialized Technical Training Services (STTS) Program, AMERICAN SYSTEMS assists the 412th EWG with the development, maintenance, and delivery of training courses; the operation of the EW T&E U; and the integration of all elements of this program with other EW T&E U activities, as required.

The STTS Program focuses on the long-term mission performance needs of 412th EWG T&E personnel and is designed to help EW test engineers achieve the required understanding necessary for proficiency and excellence in their work as quickly as possible.

The STTS Program offers the following capabilities:

- Made-to-order and off-the-shelf EW T&E training
- World-class, EW T&E-experienced instructors
- Proven, classified course development
- Online EW test reference development
- Computer-based training

OFF-THE-SHELF EW T&E COURSES

Electronic Warfare Fundamental Concepts (EWF)

These courses provide a solid foundation in the basic concepts associated with testing EW systems. While they are aimed at new engineers and practicing engineers new to the EW field, they also provide good refresher training for experienced engineers.

Electronic Warfare Systems Under Test and Survivability (EWS)

These courses focus on the systems under test, such as EW receivers, electronic countermeasures systems, towed decoys, expendable countermeasures, and low observable concepts.

Electronic Warfare Evaluation (EWE)

These courses provide practical insights about advanced topics in test methodology, data analysis, and evaluation considerations from an EW test perspective.

Electronic Warfare Threat Systems and Air Defense Principles (EWT)

EW systems are designed to operate in and overcome enemy integrated air defense systems (IADS). The focus of these courses is to provide engineers and analysts with an understanding of the operating principles of the individual threat systems and how they are netted together to form an IADS.

EWF 0010 – Radar Fundamentals for EW T&E Engineers

Course Length: 4 days; **Classification:** Unclassified

Students learn about radar fundamentals from the perspective of the radar's interaction with EW systems. In addition to radars, addressed are specific EW systems such as radar warning receivers (RWR), self-protection jammers (SPJ), and towed decoys (TD). This fundamentals course describes basic radar functionality and uses numerical examples to demonstrate the key elements of the radar range equation. The course enables students to become proficient in solving problems dealing with basic radar detection and measurement capabilities. Once the basic operational concepts for radars are mastered, students are exposed to an analysis of the interactions that take place between the radar and the primary classes of EW systems. Student exercises reinforce key concepts.

EWF 0020 – Introduction to Electronic Warfare

Course Length: 4 days; **Classification:** Secret or Unclassified

This course provides an introduction to active and passive EW techniques against threat integrated air defense systems (IADS). The course provides students with an overview of radar and infrared systems and jamming; missile warning; communications, navigation, and intelligence (CNI); and fundamental electronic countermeasure (ECM) principles. The course objective is to provide students with a foundation of EW concepts, supporting principles, and associated impact upon the various EW-related systems under test. The course uses a building-block approach, supplemented with real-world examples, discussions, and numerical examples to reinforce student comprehension of the essential subject matter associated with self-protection and support jamming.

EWF 0040 – Graphical Analytical Concepts with MtStat

Course Length: 4 days; **Classification:** Unclassified

This course is a refresher course designed for engineers to review probability and statistic fundamentals. The course covers statistical concepts in a graphically intensive manner using the MtStat graphical and statistical package. This course covers fundamental statistics terms and techniques and addresses statistical problem solving methodology by accessing appropriate tables and performing mathematical calculations. After students are fully aware of the fundamental operational concepts, the instructor presents students with software methods to obtain solutions faster and more efficiently. Classroom exercises are included throughout the course, allowing students a hands-on opportunity to obtain essential information.

EWS 0110 – EW Receivers Systems T&E

Course Length: 4 days; **Classification:** Unclassified

This course examines the means used to intercept radio frequency emissions and discusses test procedures and resources applicable to EW receivers; radar warning receiver systems (RWR); and communications, navigation, and intelligence (CNI) receivers. The course covers fundamental technical and operational characteristics of receivers and associated systems, with specific emphasis on RWRs from the perspective of T&E practitioners. The course provides a foundation for test planning, to include profile development, for the evaluation of EW receivers. Instruction consists of a combination of lectures, demonstrations, and student exercises.

EWS 0111 – Fundamentals of High Power Microwave T&E

Course Length: 4 days; **Classification:** First two days Unclassified, third and fourth days Secret

This course provides students with a technical background in the development, operation, and applications of high power microwave (HPM) weapons. The course begins with basic definitions followed by a discussion of sources and modulation techniques used to generate high power microwaves. As the course progresses, students learn the fundamental concepts that govern the propagation of HPM energy and its interaction with a target and apply these concepts to test and evaluation techniques.

EWS 0122 – Fundamentals of High Energy Lasers T&E
Course Length: 4 days; **Classification:** Unclassified

This course provides students with a technical background in the development, operation, and applications of laser-based weapons. This course is intended as an introduction to the characteristics and functionality of high energy lasers (HEL) that are applicable to weapon systems employment. Beam generation, characteristics, control, and propagation are discussed. The final topic in this course introduces countermeasures for HEL weapons and HEL T&E techniques.

EWS 0210 – Fundamentals of Onboard ECM* T&E
Course Length: 4 days; **Classification:** Secret

This course introduces EW T&E engineers to the fundamentals of onboard radio frequency (RF) electronic countermeasures (ECM), and introduces T&E considerations for onboard ECM systems. The course covers onboard self-protection ECM against target acquisition and target track radars for both generic and specific system examples. The goal is to provide students with a foundation from which they can ask the right questions when dealing with the T&E of active RF onboard self-protection ECM systems. The course uses a building-block approach supplemented with real-world examples, discussions, and classroom exercises to reinforce student comprehension of the essential subject matter associated with onboard ECM.

*ECM is also referred to as Electronic Attack (EA)

EWE 0110 – Data Analysis and Evaluation for EW T&E Engineers
Course Length: 3 days; **Classification:** Unclassified

This course uses a unique example-based framework for presenting various statistical and analytical techniques common in EW data analysis and evaluation. The course builds upon the testing concepts presented in the **EW Receivers T&E** course and the basic statistical methods presented in the **Graphical Analytical Concepts with MtStat** course. A typical radar warning receiver (RWR) test is used as the operative example that prompts students to explore realistic problems and provide subsequent evaluations. Discussions then move from defining and structuring test objectives to determining measures of performance or effectiveness and establishing evaluation and success criteria. The problem is then taken to different levels requiring testing using different facilities and test design constraints. The effects of sample size are investigated during each iteration of the exercise. At each step, graphical and statistical methods are defined and provided to the students to apply to their individual test data sets. This allows students to receive actual hands-on experience in applying each of the statistical techniques addressed in the course.

EWE 0130 – Network Centric Warfare T&E
Course Length: 5 days; **Classification:** Top Secret//SCI; SAR

This course equips EW test engineers to understand the fundamentals of Network Centric Warfare (NCW) as applied to current and future systems under test (SUT) platforms. Emphasis is placed upon U.S. and potential foreign adversary capabilities, and their interactions in an EW and Information Operations (IO) environment. The course begins with an overview of NCW, its fundamental concepts, historical background, and the system platforms and components involved. The "Netcentricity" of NCW is then addressed whereby ground, air, sea, and space-related C4ISR sensors, platforms, and data link assets integrate into the Global Information Grid (GIG) to facilitate warfighter NCW combat operations. Actual DOD systems used to facilitate this are discussed. The "Warfare" aspect of NCW is then presented whereby integrated NCW battlespace achieves both offensive and defensive combat objectives. Selected foreign threats to NCW capabilities are addressed, and aspects of foreign NCW and counter-NCW capabilities are considered. EW, Navigation Warfare, and Cyber Warfare concepts, offensive and defense for both friendly and adversary operations, are covered. NCW test capabilities and test considerations are also addressed.

EWE 0140 – Data Reduction in EW T&E
Course Length: 4 days; **Classification:** Unclassified/For Official Use Only

This course addresses how to perform data reduction in EW T&E. Data reduction tools and methods specific to the 412th Electronic Warfare Group will be covered in detail. Material presented revolves around the construction of several realistic synchronous threat data sets. These data sets will be derived from actual collected test data obtained from typical radar warning receiver (RWR) tests, compatible with Design of Experiments (DOE) test and analysis methods, as well as from data sets currently used as examples in the Video Review and Signal State Viewer programs. The course consists of the following three major components: (1) data reduction of system under test (SUT) data, (2) data reduction of threat data, and (3) data reduction in combining threat and SUT data. Student classroom exercises will be incorporated throughout the course to reinforce key data reduction concepts.

EWT 0110 – Command Guided SAM Systems
Course Length: 5 days; **Classification:** Secret

This course covers the technical and operational characteristics of three specific command guided surface-to-air missile (SAM) systems. Topics include an overview of the concept of command guided SAM systems; the engagement scenario; the system concept of operation; antenna, receiver, transmitter, and signal processing subsystems; and missile and command links. Additionally, the course presents missile guidance law fundamentals and places those fundamentals into the context of electronic countermeasure (ECM) effectiveness T&E. The relationship between detailed system technical and performance characteristics and the test implications of system behavior are presented. Student exercises are designed to reinforce key performance concepts and their application to T&E. Students have the opportunity to tour selected command guided systems where they can get a first-hand look at operational systems, discuss class concepts with system engineers and operators, and reinforce their understanding of system T&E behavior.

EWT 0111 – Tactical Land Based Defense Systems
Course length: 5 days; **Classification:** Secret

This course covers the technical and operational characteristics of two tactical semi-active (SA) surface-to-air missile (SAM) systems and their associated radars, as well as one radar-directed anti-aircraft artillery (AAA) system. The tactical employment of each system is also addressed. Included is an overview of the SAM battery components, associated acquisition radars, target engagement radars, and missile transporter erector launcher. The transmitter, receiver, signal processing, antenna, data link, and missile seeker subsystems are also discussed. Additionally, the course presents missile guidance law fundamentals and places those fundamentals into the context of electronic countermeasure (ECM) effectiveness T&E for this class of threat systems. Phenomenology issues which may be associated with observable cause-effect behavior are also addressed. Principles of gun directing radars, including ballistic computations, are studied. Student exercises are designed to reinforce key performance concepts and their application to EW T&E. Students will have the opportunity to tour selected radar systems where they can see systems in operation, discuss class concepts with system engineers and operators, and reinforce their understanding of system T&E behavior.

"KNOW YOUR ENEMIES. KNOW YOURSELF."
– SUN TZU

EWT 0210 – Strategic Air Defense Systems

Course Length: 5 days; **Classification:** Secret

This course covers the technical and operational characteristics of selected strategic semi-active (SA) and seeker-aided ground-guided (SAGG) surface-to-air missile (SAM) systems. Specific topics include an overview of the concept of SA and SAGG SAM systems; the engagement scenario; the system concept of operation; antenna, receiver, transmitter, and signal processing subsystems; and missile and command links. The course also covers the fundamentals of continuous-wave (CW), pulse-Doppler, and phased array radar theory, and receiver and signal processing architectures that facilitate their utilization. Student exercises are designed to reinforce key performance concepts and their application to EW T&E.

EWT 0211 – Modern Air Defense Systems

Course Length: 5 days; **Classification:** First day is collateral Secret; remaining 4 days are Top Secret//SCI

This course addresses the key components of modern air defense systems. The course covers the sensors, command and control, and the weapons associated with these systems at an engineering level. The focus of this course is non-former Soviet Union countries.

EWT 0212 – Surveillance Radar

Course Length: 5 days; **Classification:** Top Secret//SCI

This course addresses selected threat air surveillance radars and their designs from an EW perspective at the engineering level. Topics include aspects of the surveillance radar equation, assessed radar design characteristics, key attributes which maximize mission performance, and their EW implications. The course also addresses the role of these radars in an integrated air defense system (IADS) and the various electronic protection features implemented in these radars to preserve mission performance. A wide variety of systems are considered. An in-class case study is conducted to reinforce key concepts.

EWT 0220 – IR Directed Threat Systems

Course Length: 5 days; **Classification:** Secret

This course presents engineering-level details of 10 infrared (IR) man-portable air defense systems (MANPADS) considered as threats to U.S. aircraft and relevant to U.S. IR countermeasures (IRCM) T&E. Information presented about these systems is that which is considered most important from an EW system under test (SUT) perspective. Included in the course presentation are key threat system design and theory of operation attributes essential for the EW test engineer to understand to effectively plan and conduct IRCM T&E. The course begins with a generic overview of the components and design theories common to all MANPADS and their subsystems. Common attributes of concept of operation among the various MANPADS under study are also presented. IR phenomenology considerations important to threat systems countermeasures T&E are also discussed. A review of IRCM and IR counter-countermeasures (IRCCM) techniques is provided. Details of each specific threat system are presented, beginning with background information on each system, and then engineering details of the various subsystems are described with emphasis upon the missile seeker and its signal processing. Imaging seeker concepts are also studied. The course concludes with discussions about various T&E strategies and issues associated with MANPADS countermeasures T&E. Student exercises, both quantitative and qualitative, are interspersed throughout the course for concept reinforcement.

"TRAIN TODAY, PREPARED TOMORROW!"

EWT 0230 – Integrated Air Defense Systems (IADS)

Course Length: 5 days; **Classification:** Secret

This course provides a unique in-depth description of threat command and control (C2) systems and algorithms. These C2 systems comprise the brains of the threat IADS. This course provides the fundamentals of what an IADS is and how it works and processes data. Designed to build a strong EW knowledge base, the course describes the operational building blocks used in creating, maintaining, and distributing an IADS air picture and applying that air picture to efficiently and effectively control the associated weapons systems. The course examines the processes at each level of the threat IADS, defines the relevant objectives for each IADS level, and conducts a detailed analysis of the methodology employed. Selected current threat country laydowns are addressed. Use of the IADS simulation tool, Digital Integrated Air Defense System (DIADS), is covered, as is model validation, verification, and accreditation.

ONE-DAY SEMINAR

Introduction to EW Threat System T&E

Course Length: 1 day; **Classification:** Secret or Unclassified

This one-day course introduces new EW T&E engineers to the subject of EW threat systems T&E. The course provides an overview of EW testing in general and the key considerations important to successful EW threat testing specifically. The course includes a "primer" on the essential design attributes common among EW threat systems for both radio frequency and infrared threats. The presentation considers those aspects of EW threat systems in general which are important to understand from an EW system under test (SUT) perspective. These attributes are then set into their functional context in order to gain an intuition about SUT cause and effect relationships, so that attendees may better understand the right kinds of information that they will need to seek out about their test systems in order to ensure good and efficient test planning and analysis.

For more information, contact:

EW T&E University email:

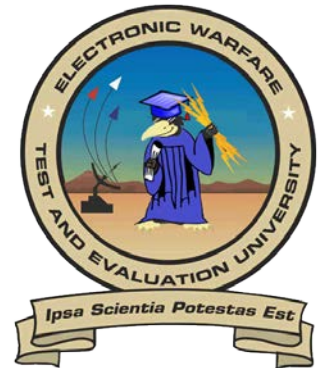ewteuniversity@us.af.mil

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Upcoming Course Schedule

Date	Course	Course Classification
October 22 – 26, 2018	Network Centric Warfare	Top Secret / SCI
November 5 – 9, 2018	Tactical Land Based Defense Systems	Secret
December 3 – 7, 2018	Strategic Air Defense Systems	Secret
December 11 – 14, 2018	Technical Writing and Powerful Presentations	Unclassified