PROFESSIONAL SUMMER AT MIT

2006

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Massachusetts Institute of Technology

The Charles Stark Draper Laboratory, Inc.

GENERAL INFORMATION

Massachusetts Institute of Technology and The Charles Stark Draper Laboratory, Inc. are sponsoring a series of classified and unclassified professional courses organized and developed by the Professional Summer Program at MIT. The courses are intended for officers and civilian personnel in government and industry working in ship systems design, analysis and production, and in specific technologies important to the U.S. Navy. This year's program will run from June 12 to August 4, 2006, and will include six courses (which may be taken individually).

The Professional Summer Program was developed to meet the needs of Navy graduate students in the Naval Construction and Engineering Program in MIT's Department of Mechanical Engineering and to provide others with an opportunity to study and discuss technical issues important to the U.S. Navy. Lecturers in the Program have been selected to present conceptual frameworks, up-to-date information, and perspectives for the future. Lecturers come from a variety of technical sources, including the U.S. Navy, industry, and academia.

This is the thirty-fifth year of the Professional Summer Program. The program of previous years has launched what has become an important and continuing forum for education and information exchange among the leaders of the military technical communities. All courses meet the "Continuous Learning Points" (CLP) requirements of the Defense Acquisition Workforce Improvements Act (DAWIA). This year's course schedule is:

Ship and Submarine Signatures

June 12 – June 16, 2006 Dr. Jan Niemiec Tuition: $1,450

Surface Ship Combat System Design Integration

June 19 – June 23, 2006 CAPT Barry Tibbitts, USN (Ret.) Tuition: $1,450

Submarine Combat Systems

June 26 – June 30, 2006 Mr. Gary Streimer, Mr. Richard C. Chapman Tuition: $1,450

Submarine Concept Design

July 10 – July 21, 2006 CAPT Jeff Reed, USN Tuition: $2,900

Shipbuilding Operations and Technology

July 24 – July 28, 2006 Dr. Philip Koenig Tuition: $1,450

Weapons Effects and Ship/Submarine Survivability

July 31 – August 4, 2006 Mr. Robert R. Wunderlick Tuition: $1,450

PROGRAM INFORMATION

LOCATION: The Professional Summer Program is hosted by The Charles Stark Draper Laboratory, Inc., formerly a division of MIT, and is held in a classroom adjacent to MIT's main campus at 555 Technology Square (Duffy Building) Cambridge, MA 02139. (See map on Page 7).

COURSE ELIGIBILITY: Applicants will be expected to have mature technical backgrounds which, either through experience or education, are at least equivalent to graduate education. U.S. government personnel and civilian contractor personnel with necessary security clearance and sponsorship are permitted to attend all courses. See the course descriptions for details. The Shipbuilding Operations and Technology course is open to the public

APPLICATION AND TUITION: We encourage students to submit an application using our web-based form at <http://web.mit.edu/13A/profsum/>. An application for admission is also included at the end of this brochure**. Applications must be received either electronically or via mail or fax at the following address two weeks prior to the commencement of each specific course:**

Massachusetts Institute of Technology
Department of Mechanical Engineering
77 Massachusetts Ave.
MIT Room 5-317, Cambridge, MA 02139-4307
Attn: Mary Mullowney
FAX: (617) 753-4962, e-mail: profsum@mit.edu

All courses are $1,450 with the exception of the two-week Submarine Concept Design course, which is $2,900. Payment must be made in full with the application. Government employees may include a copy of the DD1556 form with the application instead of an actual payment. **Make checks payable to MIT Account #1388600. To pay for a course with a MasterCard or Visa credit card, or if you have questions regarding payment for the course, contact Carolyn Brooke at (617) 253-4332 or cbrooke@mit.edu**.

CANCELLATION: Cancellations less than seven days prior to the start of a course will be subject to a $100.00 charge. Substitution is allowed if the security clearance can be processed.

ACCOMMODATIONS: Each student must arrange transportation and hotel accommodations. The cost of hotel accommodations is not included in the course tuition. Hotel space in Cambridge is very limited during the summer, so early reservations are highly recommended. A block of hotel rooms at the MIT contracted rate of $165 plus taxes has been reserved at the University Park Hotel (The Hotel@MIT, See Page 6). Rooms are available for all courses.

The rate of $165/day is reasonable for the Boston/Cambridge area**. The block of rooms will only be held up to four weeks before the start of each specific course.** Please call the reservations department at 617-577-0200 no later than one month before the start date of the desired program and **request the MIT Professional Summer program student rate for the course you want.** The hotel is within walking distance of The Charles Stark Draper Laboratory, and provides convenient access to the MBTA Red Line at the Central Square station. **When making reservations, be sure to specify that you are with the MIT Professional Summer Program and what course you are taking.** Car rental is neither necessary nor recommended.

DAILY SCHEDULE AND ATTIRE: **Unless otherwise noted**, the daily routine for the classes will be as follows:

Monday-Thursday	0800-1600
Friday	0800-1200

Each class may vary the schedule slightly. **In order to reduce the personnel congestion going into the Draper Facility, we ask that you do not show up prior to 0730 on the first day of class**.

Security badges and classroom assignments will be given out at the information table in the lobby. **The dress for the class is casual. (Business attire is neither required nor desired).** Pastries, coffee and juice will be provided in the morning, and a snack will be provided in the afternoon. During courses, messages may be left for students at FAX (617) 258-2333.

PORTABLE ELECTRONIC DEVICES: Attendees are not to bring personal laptops, personal digital assistants (PDAs), and cellular phones with photography capability to the classroom at Draper. Devices which have audio or video recording, or photo capability ***are not permitted*** in the laboratory as they create accountability and safekeeping problems which we are not resourced to handle.

SECURITY CLEARANCE: Except for the Shipbuilding Operations and Technology course, all registrants, military and civilian, must be sponsored, for security purposes, by the U.S. government and must have the appropriate security clearance. See the individual course descriptions for clearance required. All applicants must mail an official Visit Request (OPNAV 5521/27) with clearance information, sponsor identification, and specific course name to:

The Charles Stark Draper Laboratory, Inc.
555 Technology Square
Cambridge, MA 02139-3563
Attn: Mrs. T. Imbornone, Room 2194D

VISIT REQUESTS MUST BE RECEIVED TWO WEEKS PRIOR TO THE START OF EACH COURSE. Include only the period of the course as the visit dates requested (as opposed to requesting a visit period of one year). For security questions only, contact Mrs. T. Imbornone (e-mail: timbornone@draper.com). Clearances may also be sent by facsimile to the Charles Stark Draper Laboratory. The facsimile number is (617) 258-2000.

FOREIGN APPLICANTS: Prior to sending the application, contact the Program Coordinator (contact information provided below) to establish your eligibility for the desired course. Foreign personnel applying for Professional Summer Courses should allow sufficient time to process the necessary security paperwork (recommend a minimum of 3 months). Below is a brief outline of the process to follow:

1. Contact the appropriate embassy in Washington, DC.
2. The embassy will fill out a visit request and send it to the Navy International Programs Office (NIPO).
3. NIPO will contact NAVSEA (the Naval Sea Systems Command) for the course policy guidance.
4. NIPO will then send the visit request to The Charles Stark Draper Laboratory, Inc.
5. Contact the Program Coordinator one-month prior to class to verify clearance status.

The first four steps of the process described above will take an average of **4 weeks** to complete (based on past experience). **Ensure that you track the status of your visit request at each step. It is your responsibility to ensure the clearance is received in sufficient time.** Please call the Program Coordinator if you are experiencing any problems.

QUESTIONS: For further information regarding any aspect of the Professional Summer Program, contact the Program Coordinator via any of the means listed below:

Professional Summer Program Coordinator

Massachusetts Institute of Technology
Department of Mechanical Engineering, Center for Ocean Engineering
77 Massachusetts Ave., MIT Room 5-317
Cambridge, MA 02139

(617) 324-2237 FAX: (617) 753-4962

E-mail: profsum@mit.edu (preferred means)

Professional Summer Internet Web Site: <http://web.mit.edu/13A/profsum/>

UNIVERSITY PARK HOTEL (THE HOTEL@MIT)

Phone: (617) 577-0200 or (800) 222-8733; FAX: (617) 494-8366, <http://www.hotelatmit.com/>

Located in the heart of Cambridge academia, University Park Hotel at MIT is a unique blend of cosmopolitan accommodations and high-tech amenities. The 210 well-appointed guestrooms and suites combine the warm atmosphere of a private study with ergonomically designed furniture, dataports and dual telephone lines.

Guests enjoy valet and 24-hour room service, exercise facilities and the business center.

Sidney's Grill offers fine American cuisine and seasonal specialties in a unique, highly stylized decor. Throughout the restaurant, the warmth of cherry wood is mirrored in the shimmer of copper and brass fixtures. Sidney's signature style, both contemporary and eclectic, is reflected in every detail, including custom-made china. The refined comfort of The Library is ideal for small business gatherings or just relaxing.

Meeting and banquet facilities include a spectacular outdoor roof garden that's an idyllic setting for breakouts, social events and receptions.

Nearby are the boutiques and restaurants of Harvard Square, the city of Boston and the shops of Newbury Street. Public transportation, conveniently close, brings you to Faneuil Hall and Quincy Market, Boston's Public Gardens and other area attractions in minutes.

From South: Follow Rte 3N or Rte. 95N to I-93N. Take Storrow Drive West to the Massachusetts Avenue, Rte 2A/N exit. Go right off exit, over bridge. After four lights, turn left onto Sidney Street (University Park Hotel at MIT is exactly one mile after right turn onto Massachusetts Avenue).

From West: Follow I-90 East (Mass Pike) to Exit 18, Cambridge/Somerville. Over bridge, straight onto River Street. At fourth light, turn right onto Massachusetts Avenue. Go through three lights and turn right onto Sidney Street.

From North: Follow 95S to 93S. Take Storrow Drive West, to the Massachusetts Avenue, Rte. 2A/N exit. Go right off of exit, over bridge. After four lights, turn left onto Sidney Street. (University Park Hotel at MIT is exactly one mile after right turn onto Massachusetts Avenue).

From Logan International Airport: Follow signs through Sumner Tunnel to Rte 93N to Storrow Drive West, to the Massachusetts Avenue, Rte 2A/N exit. Go right off the exit, over bridge. After four lights, turn left onto Sidney Street. (University Park Hotel at MIT is exactly one mile after right turn onto Massachusetts Avenue).

MAP

SHIP AND SUBMARINE SIGNATURES

Objective

The objective of this course is to provide the student with a fundamental understanding of ship and submarine signatures. Signatures are the energy emitting and reflecting characteristics that are used for detection, classification and targeting. Basic theory, threats, signature examples, modeling and reduction techniques will be presented. Radar, infrared, magnetic and acoustic ship signatures and acoustic and magnetic submarine signatures will be covered. Principles and techniques will be brought together in problem sets and design projects and, at course end, in application to current ship and submarine examples. (A scientific calculator is required.)

Upon completion of this course, the student will be able to:

1. Understand fundamental principles of signatures.
2. Perform basic signature calculations.
3. Be aware of the exploitation of signatures by threats.
4. Recognize the sources of signatures.
5. Appreciate the capabilities and limitations of reduction techniques.
6. Apply low observable technology in ship and submarine design and operation.

Outline

Day 1:

Course Overview and Security

Radar

Threats, Physical Principles, Signature Examples, Shipboard Sources, Reduction Techniques, Modeling, Design Example, Measurements, Overall Effectiveness, Problem Set and Design Project

Day 2:

Magnetics

Threats, Physical Principles, Ship Signatures, Submarine Signatures, EM Signature Reduction Techniques and Measurement Facilities

Infrared

Threats, Physical Principles, Signature Examples, Infrared Emission and Sources, Reduction Techniques, Design Project

Day 3:

Low Observable Technology Application – Ships

Requirements Development, Low Observable Design Methodology,
Topside Design and Sensor Integration, Current Ship Examples

Acoustic Radiation

Ship and Submarine Sources, Measurement Techniques

Structural Acoustics

Physical Principles, Modeling, Problem Set

Day 4:

Hydroacoustics

Hydroacoustic Principles, Modeling, Submarine Sources, and Reduction Techniques

Acoustic Target Strength

Physical Principles, Predictive Modeling, Measurements, Hull Treatments, Problem Set and Design Project

Day 5 (morning):

(Sessions A and B concurrent)

Acoustic Target Strength Applications – Session A for U.S. Contractors

Measurement Facilities, Predictions, Submarine Signature Examples, and Design Requirements

Acoustic Technology Application – Session B for U.S. Government only

Threats, Reduction Techniques, Submarine and Ship Radiated Noise Signatures, Requirements Development, Acoustic Design Methodology, Current Submarine Examples

Lecturer-In-Charge

Dr. Jan Niemiec	Senior Scientist for Structural Acoustics and Target Strength in the Ship Signatures Department, Naval Surface Warfare Center – Carderock Division (NSWCCD)

Lecturers

Mr. Paul A. Chatterton	Head of Non-Acoustics Signature Division, NAVSEA (05T1)
Dr. Mathew Craun	Head of Structural Acoustics and Target Strength Branch, NSWCCD
Mr. David Etherton	Senior Scientist for Infrared Signature Control Technology, NSWCCD
Dr. Theodore Farabee	Senior Scientist for Hydroacoustic Control Technology, NSWCCD
Mr. Michael Gresco	Senior Scientist for Electromagnetic Signature Control, NSWCCD
Mr. Nelson Keech	Chief Engineer for Acoustic Trials Division, NSWCCD
Mr. James H. King	Senior Scientist for Electromagnetic Signatures Control Technology Division, NSWCCD / Signatures Thrust Leader, ONR

Dates and Tuition

Dates: June 12 – June 16, 2006
Tuition: $1,450

NOTE: This course is available to active-duty U.S. naval officers, current U.S. government employees, and U.S. civilian contractor personnel with U.S. government sponsorship. It is not open to foreign nationals. A **SECRET** security clearance is required.

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SURFACE SHIP COMBAT SYSTEM DESIGN INTEGRATION

Objective

The objective of this course is to provide the background knowledge required to: (1) Take a set of mission requirements; (2) Select a combat system suite to satisfy the requirements and constraints; (3) Integrate that combat system into a balanced and effective ship design; and (4) Measure its effectiveness. An appreciation of the complex electromagnetic environment associated with modern warships will be gained. The student will gain an understanding of the strengths and weaknesses of contemporary topside design models**. This course emphasizes the integration of topside systems,** i.e. guns, missiles, and radar and communications antennas.

Upon completing the course, the student will be able to:

1. Translate mission requirements into combat system/weapons characteristics.
2. Conduct performance trade-offs between alternate combat system elements.
3. Identify the major systems competing for topside space.
4. Quantify how arrangements influence system performance.
5. Develop a rudimentary topside arrangement.

All students should bring a scientific calculator for class problems.

Topics

Topside Design Process
The goal of the topside designer is to maximize overall ship performance in meeting mission requirements. Teams of naval architects, marine engineers (mechanical and electrical) combat system engineers, and ship integrators working in concert accomplish this. Emphasis is placed on locating primary mission-related elements, followed by ship self-defense, communications, navigation and other systems. Ship constraints include superstructure, propulsion intake and uptake stacks, cranes and boats, flight deck operating envelopes, other competing weapons/sensors, mast height restrictions, green water, ship motions, Panama Canal, etc. After placing the various topside elements, their individual performance and that of the entire ship is assessed. Typically, the design is iterated.

Design Project 1
Student teams will develop an AAW local area/point defense self-defense system for a combatant ship from a candidate list of contemporary foreign and U.S. guns, missiles, and target acquisition systems. Elements will then be physically located topside, taking into account constraints such as ship geometry, flight deck envelope, Panama Canal restrictions, ship motions, and green water. Cost constraints must also be satisfied. Arc-of-fire diagrams will be produced. The selected suite will then be evaluated against a raid of four state-of-the-art anti-ship missiles. Students will determine when and with which weapons to engage each target. Reaction time/range lines will be developed for each threat, and PK's (kill probabilities) computed. The bottom-line figure of merit for the self-defense system will be how many missiles struck own ship. Afterwards, the Navy solution to the same problem will be described, including the rationale for the decisions.

Electromagnetic Engineering
Electromagnetic Interference (EMI) is rapidly becoming one of the major contributors to mission degradation in the fleet today. The quantity of electronics aboard warships continues to grow at a tremendous rate (an aircraft carrier has more than 125 antennae topside). Many of these systems (sensors, active ECM, exterior communications, aircraft control systems, etc.) are intended to be capable of being used simultaneously. Unfortunately, some of these systems may interfere with each other, leading to degraded performance. All of these factors need to be considered during ship design. Examples of current fleet problems and their solutions will be provided, and the current state of the art in predicting EMI will be discussed.

Signature Control
Because of the earth's curvature, it is the ship's topside which first comes into view - both visually and electronically. The following subjects will be covered: (1) Platform Control - the shaping of structure and hiding systems and equipment to achieve the architectural portion of platform signature goals; (2) System Control - the modification or replacement of antennas, sensors, and weapon systems to achieve the system portion of platform signature goals; and (3) Arrangement - the topside arrangement of systems to distribute individual signature contributions across the platform thus achieving a balanced signature profile.

Design Project 2
Student teams will physically locate the major remaining elements of the combat system: air traffic control radar, surveillance radar, navigation radar, communications antennae and ECM so as to minimize EMI. Students will be required to address several "pairs" of system elements that have known EMI problems, and to provide solutions. This may necessitate some re-arrangement of the self-defense elements located in Design Project 1, with a subsequent degradation in performance. Afterwards, the Navy solution to the same problem will be described, including the rationale.

Integrated Topside Design
In addition to enhancing sensor (and weapons) coverage and performance, an integrated topside design is required to achieve the signature requirements for future ships. In the past, equipment design was accomplished independently of the topside design in a serial, stovepipe fashion. The systems being integrated were by-and-large stand-alone systems, and their integration was ad hoc and occurred late in the process for a specific ship program. The Navy has recognized that such an approach is no longer adequate because future performance requirements are so challenging. The new thrust utilizes a concurrent engineering approach, and involves all the technology "stake holders" early on. The status of several new Topside Technologies, such as AEM/S, LO Stack, MERS, multi-function apertures, and composite structures, will be discussed.

Lecturer-in-Charge

CAPT Barry Tibbitts, USN (Ret.)	Senior Lecturer, Department of Mechanical Engineering MIT

Lecturers

Marshall Baugher	NSWC Dahlgren Division, Topside Design Group
Mike Means	NSWC Dahlgren Division, Topside Design Group
Neal Stetson	NSWC Dahlgren Division, Topside Design Group
Daniel Tam	SPAWAR Systems Center, C4ISR Topside Design

Dates and Tuition

Dates: June 19 – 23, 2006
Tuition: $1,450

NOTE: A **CONFIDENTIAL** security clearance is required. This course is open to U.S. Military, U.S. government employees, and US government civilian contractors who have U.S. government sponsorship. It is not open to foreign nationals. Course is limited to 32 students.

SUBMARINE COMBAT SYSTEMS

Objective

The objective of this course is to provide the student with overall knowledge of submarine combat systems and the rationale, as well as the factors that drive their design. The impact of submarine missions, operating environment and threat, as well as platform design considerations. The performance and design of individual combat subsystems such as sonar, combat control, communication, ESM, electro-optical imaging, weapons, payloads, and launcher systems are addressed. Change in emphasis regarding technology insertion and payload selection for follow-on Virginia SSNs, Trident SSGN conversions, and SSGN follow-on platforms will be addressed.

The course covers current, as well as future, trends in submarine combat systems including:

1. A brief review of submarine operations during the Cold War period including key events and lessons learned.
2. Characteristics and capability of the SSN-688 Los Angeles, SSN-21 Seawolf and Virginia Class SSNs.
3. The Submarine Force's increased emphasis on Power Projection, Special Warfare, ISR/I&W, and Mine Countermeasures as well as traditional missions such as ASW and ASUW will be discussed in detail.
4. The Virginia Class experience involving the use of COTS and the Insertion of Technology Re-fresh employing the ARCI process.
5. The course will cover advanced SSN/SSGN payloads and the Navy experimentation process involving NWDC. The recommendations of the CNO's ASW Team A and B will be addressed in terms of the future implications.
6. Full spectrum to ASW will be covered in detail.

Upon completion of the course, the student is able to:

- Appreciate various aspects of the post-cold war security environment, which emphasizes regional conflict involving Third World threat and littoral operating environments.
- Identify combat system functions and interface requirements. - Identify and quantify system design considerations, drivers and performance metrics, including use of COTS and the ARCI process.
- Identify the interaction between combat system and ship design considerations. - Appreciate future submarine combat system trends - Understand submarine technology management process, technology selection and prioritization that will be needed to provide future capabilities.

Outline

Day 1:

Introduction and Overview of Submarine Missions and Roles

Historical Review of Submarine Design Trends, Perspective of Submarine Operations During the Cold War Period, Key Events and Documents During the Post Cold War Adjustment Period

Future Technology and Mission Payload Selection Options

Day 2:

Communications/Electro-Magnetic/Electro-Optical Systems

Mission importance of communication/imaging/ESM - Environmental effects and associated impact

System architecture/antenna configuration/connectivity

Current and future systems capability - Advanced concepts for future mission emphasis

Sonar Arrays (Hull Arrays, Towed Arrays, and Off-Board Arrays) and In-Board Processing

Mission importance of sonar sensors - Operational requirements and special features

Acoustic array system and information processing/management

Detection/classification/contact tracking - Information processing/management

Current/future sensor systems - Advanced sonar concepts (hull/towed/high frequency) ARCI Process

Day 3:

Combat Control Systems

Mission importance of combat control - Operational requirements and special features
Current and visionary attack centers including design/layout/human factor considerations
Mission planning function/weapon employment strategy/weapon post launch guidance
Advanced concept including COTS/NDI/GOTS and dual-use commercial considerations
Overall warfare/combat systems initiating in the area of reduced manning and affordability
Contact management function and associated algorithms - Role and future impact of acquisition reform

Special Warfare Systems

Exercise results and real world tactical considerations and non-ASW requirements
Lessons Learned from Desert Storm and Iraqi Freedom submarine experiences

Day 4:

Weapon and Off-Board Vehicle Systems

Torpedo history and in-service weapons - Torpedo technology, targets, countermeasures, and UUVs
Submarine strike warfare overview - High-Level missile characteristics and real world experiences

Power Projection and Land Strike Missiles

Payload Storage and Launcher Systems

Stowage and launch subsystems - Operational requirements/special features - Countermeasures Devices

Day 5:

Future Mission Payload Options and Ship Configurations

DoD Transformation Initiatives and Their Impact on the Submarine Force, Recent Warfare Studies and Recurrent Themes, The Way Ahead and the Role of Advanced Submarine Payloads, Overview of Recent Experiments (i.e., Giant Shadow, Silent Hammer)

Summary / Review / Class Project and General Discussion

Lecturers-In-Charge

Mr. Gary Streimer	Mission Capability Manager, USW Training/Sea Warrior, NUWC
Mr. Richard C. Chapman	Vice President of Rite-Solutions, Inc

Lecturers

Mr. Wayne Banks	Mission Capability Manager, USW Special Operations, NUWC
Mrs. Pam Borden	Program Management Specialist, Rite-Solutions, Inc.
Dr. Francis Chan	Head, ESM & Imaging Systems Division, NUWC
Mr. Ray Christian	Senior Scientist, Strategic Assessment, Director Undersea Warfare, NUWC
Mr. Mr. Tom Conrad	Head, Architecture & Eng Division Combat Systems Department, NUWC
Mr. Joseph Dlubac	Senior Systems Engineer, Undersea Sensors & Sonar Systems Dept., NUWC
Mr. Charles Elste	Director, Advanced USW Platforms Office, NUWC
Dr. Gerard Exley	Head, Submarine Electromagnetic Systems Department, NUWC
Mr. Patrick Kelley	Head, Advanced Concepts Office Combat Systems Department, NUWC
Mr. William Lonardo	Head, WV PAD Analysis Staff, NUWC
Mr. George Maris	Head, Passive System Branch, Undersea Sensors & Sonar Sys. Dept., NUWC
Mr. Ed Rishmany	Mission Capability Manager, USW Strike, Sea Warrior, NUWC
Dr. Howard Schloemer	Principal Scientist, Rite-Solutions, Inc.
Mr. James Tinkham	Head, Launcher Systems and Payload Integration Division, NUWC
Mr. David Toth	Chief Engineer, Missile Launcher & Payload Integration Dept., NUWC

Dates and Tuition

Dates: June 26 – 30, 2006
Tuition: $1,450

NOTE: This course is available to active-duty U.S. naval officers, current U.S. government employees, and U.S. civilian contractor personnel with U.S. government sponsorship. It is not open to foreign nationals. A **SECRET** security clearance is required.

SUBMARINE CONCEPT DESIGN

Please **note** the following daily routine **for this course only**:

Week #1:	M, T, Th, F	0800-1700 (Lunch 1200-1300)
	W	0800-1900 (Lunch 1200-1300)
Week #2:	M, W	0800-1700 (Lunch 1200-1300)
	T, Th	0800-1900 (Lunch 1200-1300)
	F	0800-1200

You are requested to **not** show up prior to 0730 on the first day of class.

Objective

The course is intended to provide the student with an understanding of the conceptual phase of submarine design. It consists of a series of lectures on each of the most important steps in the design process. The student has an opportunity to apply these principles by completing a submarine concept design on a PC-based model.

Historical development, mission profiles, and factors influencing past design and requirements

Development of requirements into a concept meeting the constraints of submarine operations

Relationships of weight, buoyancy, volumes & hydrostatics

Determination of the speed and power relationships

Development of the structural envelope that will resist the hydrostatic and hydrodynamic forces to be encountered by the submarine

Submarine safety and its influence on design

Overview of current design, production, and costing techniques

Concept Design: Each student will prepare a feasibility study of a submarine. This study will provide an opportunity to explore new concepts and innovations.

Quonset Point Tour

An all-day field trip to the General Dynamics Electric Boat Quonset Point Facility is planned. The Quonset Point Facility is an automated hull-fabrication and outfitting facility in Quonset Point, RI. Class members will tour the facility and meet with design personnel. The tour is subject to the availability of Quonset Point personnel and restrictions on the disclosure of information imposed by the U.S. government. Bus transportation will be provided to and from Cambridge. The class will return to Cambridge in the late afternoon.

Special instructions for the class visit

1. Quonset Point is an industrial environment and visitors are required to dress accordingly. Sturdy leather shoes must be worn; sports shoes are not allowed. Long-sleeve shirts are required. Safety protection such as hats and/or glasses will be provided.
2. Cameras, cell phones with cameras, and recording devices are prohibited.
3. If circumstances require, this tour will be cancelled and additional lecture material will be substituted.

Lecturer-In-Charge

CAPT Jeff Reed, USN	Deputy Director of Submarine Design, NAVSEA

Lecturers

CAPT David Johnson, USN	VIRGINIA Program Manager
CAPT Greg Thomas, PhD USN	Portsmouth Naval Shipyard
CDR Frank Novak, PhD, USN	Associate Chair, Department of Naval Architecture and Ocean Engineering, United States Naval Academy
CDR Jeff Stettler, PhD, USN	Assistant Professor, United States Naval Academy
CDR Chris Warren, PhD, USN	SRDRS Program Manager, PMS 394, NAVSEA
LCDR Joel Harbour, USN	Executive Assistant to the Director of Ship Design, Integration and Engineering, NAVSEA
LCDR Erek Withee, PhD, USN	Project Officer, NAVSEA
Dr.Thomas Scott McCain	Ship Signatures Group / SSGN Signatures SIT Leader
Mr. Angus Hendrick	Project Officer, Advanced Submarine Technology, NAVSEA

Dates and Tuition

Dates: July 10 - July 21, 2006
Tuition: $2,900

Note: This course is available to active-duty U.S. naval officers, current U.S. government employees, and U.S. civilian contractor personnel with U.S. government sponsorship. It is not open to foreign nationals. Course limited to 30 students. A **SECRET** security clearance is required. No laptop computers are allowed in this course. Computers will be supplied for design teams.

SHIPBUILDING OPERATIONS AND TECHNOLOGY

Objective

This course provides an introduction to shipbuilding production processes, principles of shipyard operations management, and shipyard plant, equipment, and layout. Coverage includes naval and commercial shipbuilding; new construction and repair; U.S. and foreign. Current issues in shipbuilding are discussed. The emphasis is on developing an integrated picture of the shipbuilding industry and its technical processes.

Outline

Monday

Shipyard processes and material flow. The course starts with an overview of production processes, plant and equipment. Facilities layout. Material flow. Steel fabrication, subassembly, assembly, erection, pre-outfitting, outfitting. Example: building a commercial containership in a U.S. shipyard.

Physical and information processes. Design for production. The T-AKE program is introduced as an example of integrating design with production.

Shipbuilding steel fabrication process technologies. Focus on operating principles of the various fabrication and assembly processes and technologies. The use of different processes in various stages of shipbuilding. Selection of process technologies.

Shipbuilding economics. Commercial shipbuilding industry economics and costs. Shipbuilding cost breakdowns. Scale economies, series production economies. Group technology/cellular manufacturing.

Organization and structure of the shipbuilding industry. Shipbuilding issues. Structure of the naval and commercial shipbuilding industry in the U.S. and in key overseas shipbuilding regions. Characteristics of U.S., Asian, and European shipbuilding industries. Issues in shipbuilding – competitiveness in the international commercial industry; naval shipbuilding industrial base, naval v. commercial shipbuilding.

Tuesday

Production and operations management. Principles of manufacturing applied in the shipyard environment. Production planning, scheduling, and control. Accuracy control and dimensional analysis. The role of accuracy control in advancing shipbuilding production technology.

Wednesday

Laser steel processing technologies and other advanced manufacturing technologies Advanced technologies for steel fabrication, coating, and other basic construction processes. Operating principles of various welding techniques. Laser steel processing.

Shipbuilding information technology. Introduction to shipbuilding CAD and other IT applications.

Case study: Shipbuilding in South Korea. Presentation and discussion of recent developments in the world's leading commercial shipbuilding nation – South Korea.

Ship repair. How and why certain ship repair operations and technologies differ from those used in new construction. U.S. naval ship repair processes and management.

Thursday

Shipyard tour. An all-day field trip to Bath Iron Works (Bath, Maine). Bus transportation will be provided to and from Cambridge. The tour will trace the flow of material, beginning with a visit to the Hardings and East Brunswick plants, followed by an inspection of the shipyard. Afterwards, Bath Iron Works engineering, design, and production personnel will participate in a discussion. The tour and discussions are subject to the availability of Bath Iron Works personnel and restrictions on the disclosure of information imposed by the U.S. government. The class will return to Cambridge in the late afternoon. See *special instructions for the shipyard visit,* below.

Friday

Discussion of the previous day's shipyard tour to reinforce key observations.

Composite materials in ship construction.

Conclusion of the course.

Lecturer-In-Charge

Dr. Philip Koenig	Lecturer, Department of Mechanical Engineering, MIT Senior Ship Concept Manager,Naval Sea Systems Command, Washington, D.C.

Lecturers

Mr. Patrick Cahill	Atlantec Enterprise Solutions
Mr. Jim Demartini	General Dynamics Corporation, Bath Iron Works
Mr. Albert Horsmon	SP North America
LCDR Eric Lind	Naval Sea Systems Command, Washington, D.C.
Prof. Jong-Gye Shin	Department of Naval Architecture and Ocean Engineering, Seoul National University
Mr. Mark Spicknall	Department of Naval Architecture and Marine Engineering, University of Michigan
Mr. Eric Suehrstedt	General Dynamics Corporation, Bath Iron Works

Dates and Tuition

Dates: July 24 – 28, 2006
Tuition: $1,450

Special instructions for the shipyard visit

1. A shipyard is a heavy industrial environment and visitors are required to dress accordingly. Sturdy leather shoes must be worn; sports shoes are not allowed. Safety hats, glasses and ear protection will be provided.
2. Cameras, cell phones with cameras, and recording devices are prohibited.
3. If circumstances require, this tour will be cancelled and additional lecture material will be substituted.

NOTE: This course is non-classified, and is open to the public U.S. citizens include social security number and date of birth on your application. Foreign nationals please include passport information [country of issue, type of passport, number, date of issue, date of expiration], U.S. Visa information [type, issuing office, date of issue, date of expiration], citizenship, and date of birth.

WEAPONS EFFECTS AND SHIP/SUBMARINE SURVIVABILITY

Objective

The objective of this course is to provide an overview of technical principles and concepts underlying (1) the damaging effects of weapons on ship and submarine structures and equipment, and (2) the protective features that can be incorporated to mitigate these effects in ship and submarine design.

Weapons explosion phenomena and damaging effects will be discussed for most types of weapons ranging from small arms, through conventional high-explosive anti-ship and anti-submarine weapons, to weapons of mass destruction. Emphasis will be on the mechanical effects of conventional weapons phenomena. Protective features such as armor, ballistic protection, torpedo side protection, equipment shock hardening, improved compartment and equipment arrangements, and hull strengthening will be discussed.

The subject material will be presented to give the student an overall comprehension of how ship and submarine designers consider weapons effects in the ship design process, including examples form recent acquisition programs. The intent is not to teach the intricate design details of armor, shock hardening, etc., but to introduce the subject and bring the concepts together as a whole. There will be opportunity for student participation in informal discussions and classroom work problems.

Topics

Explosion Phenomena

Type of explosive; chemical detonation; characterization of shock waves in air and water; fragmentation phenomena; shaped-charge jets; underwater explosion bubble behavior; nuclear air and underwater bursts.

Damage Mechanisms

Structural blast and fragment damage from high explosive (HE) weapons bursting in air; shaped charge damage to structure, munitions, and combustibles; underwater explosion damage to structure; underwater explosions shock damage to equipment; research model tests, scaling, instrumentation, etc.

Destroyer Size Ships - Weapons Damage and Protection Features

Types of ships and anti-ship weapons; battle damage experience (WWII through USS Cole); experience from weapons effects tests against ships; effects of underwater weapons; protection goals; hardening of equipment against underwater shock; effects of conventional air weapons and structural protection against them; computer simulations of the effects of weapons hits on the operational capabilities of ships; nuclear air blast damage mechanisms and design of hardened structures.

Large Ships - Weapons Damage and Protective Features

Types of ships and anti-ship weapons; World War II battle experience; historical view of protection development; torpedo protection and ballistic armor protection.

Submarines - Weapons Damage and Protective Features

Types of submarines and ASW weapons; damage mechanisms for HE and nuclear weapons; shock hardening of equipment; hull response and protection.

Lecturer-In-Charge

Mr. Robert R. Wunderlick	Head, Survivability and Live Fire Technology Office, Naval Surface Warfare Center, Carderock Division (NSWCCD), Lecturer, Department of Mechanical Engineering, MIT

Lecturers

Mr. Thomas D. Burton	Senior Project Manager, Above Water Weapons Effects Branch, NSWCCD
Mr. Frederick A. Costanzo	Head of Underwater Shock Analysis Branch, NSWCCD
Dr. Fred J. Fisch	Senior Engineer, T Carroll and Associates
Mr. Willam Gottwald	Senior Project Manager, Underwater Shock Analysis Branch, NSWCCD
Mr. Harry P. Gray	Head of Hull Response & Protection Branch, NSWCCD
Mr. Mark W. Hoffman	Senior Project Manager, Vulnerability Assessment Branch, NSWCCD
Mr. Lawrence F. Ripley	Senior Project Manager, Hull Response & Protection Branch, NSWCCD
Mr. David T. Wilson	Senior Project Manager in Above Water Weapons Effects Branch, NSWC

Dates and Tuition

Dates: July 31 – August 4, 2006
Tuition: $1,450

NOTE: This course is available to active-duty U.S. naval officers, current U.S. government employees, and U.S. civilian contractor personnel with U.S. government sponsorship. It is not open to foreign nationals. A **SECRET** security clearance is required.