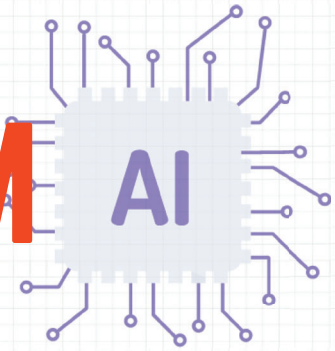
TDSI
Temasek Defence Systems Institute

DARE TO DREAM DO DELIVER



MASTER OF DEFENCE TECHNOLOGY AND SYSTEMS PROGRAMME

INFORMATION BOOKLET 2023 INTAKE

NUS National University of Singapore

Cranfield University

DARE TO

DREAM
DO
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About the Application Kit

Items in the Application Kit

1. MDTS Application Kit booklet

2. Enclosures include the following:
   a) Application Instruction and Checklist
   b) Personal Data Notice & Consent
   c) Application Form for NUS, Temasek Defence Systems Institute

Items to Include in Your Application

1. One set of completed NUS Application form, with a recent colour photograph with white background, affixed on the form

2. Signed Personal Data Notice & Consent

3. One set of Curriculum Vitae (CV) with details of your working experiences and specific courses attended that might help in your application for the programme.

4. One set of the following supporting documents in A4 size:
   a) Singapore NRIC (for Singaporeans) or Passport (International Applicants)
   b) GCE 'O' level certificate or its equivalent
   c) GCE 'A' level certificate or its equivalent
   d) Polytechnic transcript and certificate (if applicable)
   e) Degree scroll / degree certificate / Diploma
   f) University results (from 1st year to final/honours year), either in original official transcript or its certified true copies. If these are not available, please request for a copy of your transcripts from your University. NUS graduates should request for their transcripts online at:
   https://www.nus.edu.sg/registrar/student-records

Submission of Application

15 OCTOBER 2022

The completed application forms must be submitted together with all the relevant supporting documents in order to be considered complete. Completed applications should scanned and emailed to **mdts@nus.edu.sg**. Hard copies should be mail to the following address by 15 October 2022:

The Manager (MDTS Programme)
Temasek Defence Systems Institute
National University of Singapore
Block E1, # 05 - 05
1 Engineering Drive 2
Singapore 117576.

This kit is supplied purely as a guide to assist applicants in the application process. The University reserves the right to change the modules it offers and any regulations or requirements concerning its programme at any time.

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About Temasek Defence Systems Institute

Vision	A premier educational institute for nurturing systems thinkers and thought-leadership in systems thinking in defence and security
Mission	To nurture systems thinkers and leaders to advance Singapore's defence capabilities

Temasek Defence Systems Institute (TDSI) provides the platform to bring together military staff and defence technologies in an education and research environment. TDSI aims to produce graduates who understand the complexities of a military force, so as to be able to create maximum leverage by the integration of operations and technology.

Breadth + Depth

TDSI's flagship programme is the Master of Defence Technology and Systems Programme.

The aim of the programme is to educate and integrate military staff and defence technologists in planning, designing, developing, creating, operating and sustaining integrated military forces of the 21st century.

Students of this unique Masters Programme will learn by experimenting in a practical environment. They will benefit from the bond building, networking and from the interactions among the military staff, defence engineers and scientists to leverage on the opportunity highly essential for an integrated defence development.

The qualities that the students develop by taking on such an in-depth interdisciplinary experience will better prepare them to confront the challenges of the new millennium.

About Master of Defence Technology and Systems Programme (MDTS)

Objectives

This Programme provides postgraduate education in Defence Technology, Systems Engineering and Integration for military officers, defence engineers and scientists. Graduates from the programme will be:

1. Proficient in the underlying scientific principles of key technologies, both current and future, and their physical boundaries. The emphasis will be on technologies in the key capability areas of Manoeuvre War, Precision Strike, Comprehensive Awareness & Communications and Protection/Survivability.

2. Conversant in applying systems engineering methodologies and processes learnt in analysing the integration and interactions of sub-systems in large-scale systems, so as to optimize the total system performance.

3. Capable of conducting technical studies and lead in operational testing and evaluation (OT&E) efforts to expand systems' operating envelops.

4. Skilled in analysing the impact of future technologies on military operational concepts and how future operational concepts drive technological demands.

Minimum Admission Requirements

1. Bachelor of Engineering (with good honours), Bachelor of Science in Physics or Mathematics (with good honours), or an equivalent qualification acceptable to NUS and Cranfield University;

2. At least 3 years of relevant working experience; and

3. Sponsorship to this Programme by the candidate's employer.

Degrees Awarded

The MDTS is a double-degree programme. The following degrees will be awarded to students who successfully complete all the relevant modules, projects and research thesis at NUS and Cranfield University:

Master of Science (Defence Technology and Systems) degree by NUS

&

Master of Science degree in a relevant discipline awarded by Cranfield University

Application and Enrolment Schedule

There is one intake each year for this programme. All applications for the March 2023 Intake must reach Temasek Defence Systems Institute by 15 October 2022.

Applicants will expect to be informed on the outcome of their application sometime in January 2023.

Date	Event
15 July 2022	Application Opens
15 October 2022	Application Closes
January to March 2023	Applicants review Engineering Mathematics (E-Module)
9 March 2023	• Registration of Students at NUS • International students apply for Singapore Student Passes
20 March 2023	Start of MDTS Programme in NUS
September 2023	Students report to Cranfield University
September 2024	End of MDTS Programme in Cranfield University

Academic Dates

The academic programme is based on quarterly cycles. The dates for these quarters are shown in the below table:

Quarter	Dates	Venue
Q1	20 Mar 2023 to 2 Jun 2023	NUS
Q2	5 Jun 2023 to 25 August 2023	NUS
Q3 – Q6	Sep 2023 to Sep 2024	Cranfield University

For Cranfield University phase, the academic dates depend on which campus candidates select. The dates will be shown in the offer letter given by Cranfield University.

Structure of Programme

The Programme is structured into two parts:

Common Curriculum	• Common modules conducted at NUS • Integration Project conducted at Cranfield University
Specialised Curriculum	• Specialised modules conducted at Cranfield University • Thesis Research conducted at Cranfield University

The structure of this programme is illustrated in **ANNEX A.**

Curriculum

1. Candidates are required to complete a programme of study comprising the MDTS Common Curriculum and a Specialised Curriculum of the candidate's choice.
2. A brief description of the modules under the Common Curriculum is shown in **ANNEX B.**
3. Candidates may select any specialization course (so long as there is agreement between candidate and the respective sponsor) in Cranfield University offered by either:
   - School of Aerospace, Transport and Manufacturing or
   - Cranfield Defence and Security
4. The Specialised curriculum is available in Cranfield University's website: http://www.cranfield.ac.uk
5. Candidates are expected to take 1.5 years to complete this programme under normal circumstances.

Prerequisites

Candidates are to ensure that they satisfy the relevant prerequisites modules for the selected specialisation track of the MDTS programme.

Examinations

1. Candidates will be examined at the end of each quarter of their study for the coursework modules.
2. The Board of Examiners of the respective universities will decide the examination results of the modules offered at each university. Each university will issue the examination results to candidates reading their respective modules.
3. The universities will exchange results of the students.

Further Information and Contact

1. Students need to provide for their own meals, lodging, transportation, entertainment, books and stationeries. A list of the estimated cost for such expenditure accompanies this booklet.
2. Please visit TDSI's website for more information and updates at *tdsi.nus.edu.sg*
3. If you need further clarification, you may contact:
   Ms Wong Hsiao-Szu
   tdswhs@nus.edu.sg

Annexes

Annex A	Master of Defence Technology and Systems (MDTS) Programme Structure
Annex B	MDTS Common Curriculum Course Description

Master of Defence Technology and Systems (MDTS) Programme Structure

MDTS Programme Structure

The MDTS programme is divided into two parts, the Common Curriculum and the Specialised Curriculum. Upon completing the course successfully, students will be awarded the following:

- Master of Science (Defence Technology and Systems) degree by NUS; and
- Master of Science degree in a specialised field by Cranfield University.

MDTS Programme Structure				
Quarter		Venue	Common Curriculum MSc (DTS)	Specialised Curriculum MSc (specialisation)
Q1	Mar to Jun	NUS	Coursework	--
Q2	Jun to Sep	NUS	Coursework	--
Q3 – Q6	Sep to Sep the following year	Cranfield University	Integration Project	Coursework & Thesis Research

The Common Curriculum aims to provide students with a broad range of knowledge pertaining to systems engineering and introduction to key defence technologies. Here, the learning emphasis is on systems thinking. Students have to take all the coursework modules conducted in NUS within the first 2 quarters of the programme. The students then proceed to Cranfield University where they will embark on the "Integration Project" over the subsequent 3 quarters.

The Specialised Curriculum aims to provide students with in-depth knowledge of a specific field in defence technology. Students are required to choose one of the specialisation programme offered by "School of Aerospace, Transport and Manufacturing" or "Cranfield Defence & Security". Students are to complete the required courses and a "Thesis Research" offered by Cranfield University.

MDTS Programme – Common Curriculum Overview

The common curriculum modules conducted in NUS are shown in the table below.

NUS Degree: Master of Science (Defence Technology and Systems)	
Pre-Course Modules	
	Engineering Mathematics (refresher course)
	Probability and Statistics (refresher course)
Quarters 1 and 2 (Mar to Sep) at NUS Singapore	
DTS5701	Large Scale Systems Engineering
DTS5702	C3 Systems
DTS5703	Operations Research
DTS5731	Fundamentals of Systems Engineering
DTS5732	Artificial Intelligence & Data Analytics
DTS5733	Sensors & Intelligence
DTS5734	Guided Systems
DTS5735	Cyber Security
DTS5736	Systems Design Project
Quarters 3 to 5 (Sep to Jun) at Cranfield University, UK	
	Integration Project conducted at Cranfield University

MDTS Common Curriculum

Course Description

Engineering Mathematics (Online Refresher Module)

- Introduction to vector fields, vector algebra and partial derivatives of vector and scalar fields.
- Gradient, divergence and curl.
- Introduction to line, surface and volume integrals; Green's Divergence.
- ODE classification and general solutions.
- First and second-order homogeneous and non-homogeneous ODEs.
- Introduction to error and sensitivity analyses.
- Matrix algebra: introduction and notation; rank, determinants, transpose and inverse; simple elementary row operations and linear independence; eigenvalues and eigenvectors.
- Complex numbers: introduction and geometrical representation; Argand diagram; complex algebra; Euler's representation and De Moivre's theorem.
- Fourier analysis: concept of transforms; Fourier series and orthogonality relations; Fourier transforms and applications.
- Probability axioms and event probability.
- Random variables and their probability distributions.
- Hypothesis testing, conditional probability and expectation.

Probability & Statistics (Online Refresher Module)

Topics include:

- Descriptive Statistics
- Probability Concepts
- Conditional Probability
- Discrete Distribution
- Continuous Distribution, Non-normal, Multivariate

DTS5701 Large Scale Systems Engineering

Large Scale Systems Engineering deals with the complexities of large-scale systems. The Systems Approach and Systems Engineering methodologies are used to understand and conceptualize the key issues in the planning, design and management of large scale systems.

The module aims to help students learn about Large Scale Systems Engineering (LSSE) with theories, stories and case studies on how systems are planned and implemented.

By the end of the module, students are expected to be able to analyse and synthesise systems and design large-scale projects using the LSSE framework taking into consideration their goals, boundaries, stakeholders, complexities, trade-offs, risks and unintended consequences.

DTS5702 C3 Systems

This module provides the key underlying principles and concepts of C3 engineering and their application in the design, development and integration of C3 systems in modern armed forces.

Using a systems engineering approach, the module will also enable participants to have a good appreciation of the key considerations and challenges as well as good engineering practices associated with C3 design and integration with sensor and weapon systems.
Topics related to emerging trends, concepts and technologies will also be covered.

DTS5703 Operations Research

This is an introductory module to operations research which will cover both deterministic and stochastic models for effective decision-making.

Topics include Mathematical programming (overview on models building and sensitivity analysis; computer-based solutions), multi-criteria decision analysis, reliability and maintenance, queueing theory and simulation. Relevant cases on military applications will be discussed.

DTS5731 Fundamentals of Systems Engineering (Online Module)

This module is an introductory module providing an overview of the topic and a flavour of the details which should be more fully explored in depth through other modules. It explains systems, systems engineering, lifecycles, associated activities, products, applications, processes, models, methods and strategies.

DTS5732 Artificial Intelligence and Data Analytics

This is an introductory module to artificial intelligence (AI) and data analytics (DA). It covers various topics of AI and DA.

The AI topics include heuristic search, constraint satisfaction, logic and inference, and natural language processing. The DA topics include data pre-processing, data visualization, classification, model evaluation, decision trees, neural networks, deep learning, association analysis, and clustering.

DTS5733 Sensors & Intelligence

This module introduces sensor and intelligence technologies and their applications in the operational context. It focuses mainly on the most commonly deployed sensor technologies such as Radar and Electro-Optical (EO) sensors as well as established and emerging intelligence areas such as communications intelligence (COMINT), electronic intelligent (ELINT) and Open-Source Intelligence (OSINT).

The underlying technical principles for performance assessments in various environments, such as electronic warfare and design trade-offs will be covered and reinforced through the use of application examples.

DTS5734 Guided Systems

The module covers the principles, technologies and operational aspects of smart weapon systems e.g. guided weapons, precision munitions and unmanned vehicles (UxVs).

The interplay of various sub-systems for target identification & tracking, guidance/navigation, command and control and their impact on mission effectiveness will be examined with consideration of counter-measures and counter-counter-measures. Additional topics include advanced concepts for autonomy, interoperability and teaming and cooperation. The course will include case studies of these weapon systems in actual combat.

DTS5735 Cybersecurity

This module introduces cybersecurity concepts and their applications. It aims to illustrate how systems can fail under malicious activities, and how the threats can be mitigated and managed.

Topics include cryptography, communication channel security, system security, trusted computing, policy making, human factors, etc. Applications such as cloud security, IOT security, security operations centre, AI in cybersecurity, and case studies on well-known attacks will be used to reinforce the learning of various foundational concepts.

DTS5736 Systems Design Project

The purpose of this module is to allow students to practise Systems Engineering Applications in realistic large scale defence/security problem solving.

Students are required to adopt the systems approach in problem definition/framing and applying various technical disciplines taught in this programme, e.g. C3, Sensors and Intelligence, DA/AI, Guided Weapons, Unmanned Systems, Cyber, Operations Research etc., in developing the system solutions. They are expected to conduct systems engineering studies to formulate and synthesize sound and cost effective systems solutions to address the operational requirements and scenario.