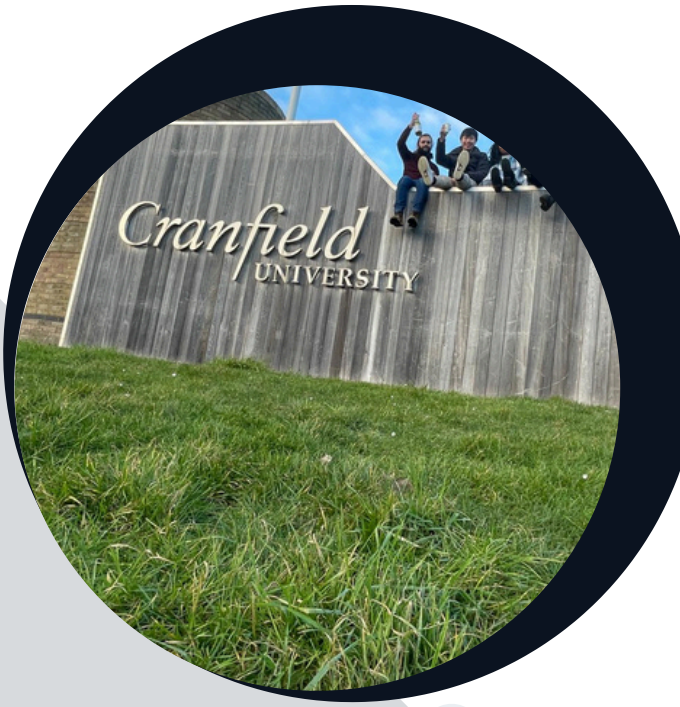
NUS National University of Singapore

TDSI Temasek Defence Systems Institute

MASTER OF DEFENCE TECHNOLOGY AND SYSTEMS PROGRAMME

INFORMATION BOOKLET FOR 2025 INTAKE



Cranfield University

DARE TO

DREAM
DO
DELIVER

TEMASEK DEFENCE SYSTEMS INSTITUTE
National University of Singapore
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Singapore 117576
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Website: tdsi.nus.edu.sg

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 2024

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 2024:

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

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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 2025 Intake must reach Temasek Defence Systems Institute by 15 October 2024.

Applicants will expect to be informed on the outcome of their application sometime in January 2025.

Date	Event
15 July 2024	Application Opens
15 October 2024	Application Closes
January to March 2025	Applicants review Engineering Mathematics (E-Module)
19 March 2024	Registration of Students at NUS Welcome Briefing
24 March 2025	Start of MDTS Programme in NUS
September 2025	Students report to Cranfield University
September 2026	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	24 Mar 2025 to 6 Jun 2025	NUS
Q2	9 Jun 2025 to 29 August 2025	NUS
Q3 – Q6	Sep 2025to Sep 2026	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 courses conducted at NUS • Integration Project conducted at Cranfield University
Specialised Curriculum	• Specialised courses 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 Curriculum and a Specialised Curriculum of the candidate's choice.
2. A brief description of the courses under the NUS Curriculum is shown in **ANNEXB.**
3. Candidates may select any specialisation 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. Students are expected to take 18 months to complete the MDTS programme, however, they may extend the NUS Curriculum beyond quarter 1 and quarter 2 if they select the expanded non-TDSI electives or Thesis Project (local). Maximum candidature period is 36 months.

Prerequisites

Candidates are to ensure that they satisfy the relevant prerequisites courses 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 courses.
2. The Board of Examiners of the respective universities will decide the examination results of the courses offered at each university. Each university will issue the examination results to candidates reading their respective courses.
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.
2. Please visit TDSI's website for more information and updates at *https://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 NUS Curriculum Course Description

Master of Defence Technology and Systems (MDTS) Programme Structure

MDTS Programme Structure

The MDTS programme is divided into two parts, the NUS Curriculum and the Specialised Curriculum. Upon completing the courses 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 (CU).

MDTS Programme Structure				
Quarter		Venue	NUS Curriculum MSc (DTS)	Specialised Curriculum MSc (specialisation)
Q1	24 Mar to 6 Jun 2025	NUS	Coursework	--
Q2	9 Jun to 29 Aug 2025	NUS	Coursework	--
Q3 – Q6	Sept 2025 to Sept 2026	CU	Integration Project	Coursework & Thesis Research
Q7*	Sep 2026 Onwards	NUS	Coursework or Thesis Project (Local)	

** Students who select the expanded electives or Thesis Project (Local)*

The NUS 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. The Integration Project will be conducted at Cranfield University over 4 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 – NUS Curriculum Overview

Students are required to complete a total of 20 units of Core courses, 12 units of Elective courses and obtain a satisfactory grade for Integration Project. The NUS curriculum is shown in the table below.

NUS Degree: Master of Science (Defence Technology and Systems)		
Pre-programme Refresher Courses (Jan – March)		
Engineering Mathematics (refresher course)		
Probability and Statistics (refresher course)		
Quarters 1 and 2 (Mar to Sep) at NUS Singapore		
Core Courses (20 units)		
DTS5701	Large Scale Systems Engineering	4 units
DTS5702	C3 Systems	4 units
DTS5731	Fundamentals of Systems Engineering	2 units
DTS5732	Artificial Intelligence & Data Analytics	4 units
DTS5735	Cybersecurity	4 units
DTS5736	Systems Design Project	2 units
Elective Courses		
DTS5703	Operations Research	4 units
DTS5733	Sensors & Intelligence	4 units
DTS5734	Guided Systems	4 units
Quarters 3 to 6 (Sep to Sep) at Cranfield University (CU)		
	Integration Project conducted at CU	8 units
Quarter 7 (Sep) onwards at NUS Singapore		
Expanded Elective Courses *at NUS, Singapore*		
DTS5712	Thesis Project (Local)	8 units
EE5112	Human Robot Interaction**	4 units
ME5311	Data-Driven Engineering and Machine Learning**	4 units
ME5418	Machine Learning in Robotics**	4 units

*** Offered by Department of Electrical and Computer Engineering or Department of Mechanical Engineering in NUS Semester 1 (August) or 2 (January).*

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.

EE5112 Human Robot Interaction

The module introduces different modes of human robot interactions, methods for detecting humans, understanding human behaviors and intentions, and methods for humanrobot coordination and collaboration. Human-robot interactions include physical and non-physical (e,g, social) interactions. Physical interactions include human assistance and wearable robotics. Non-physical interactions include natural language understanding, gestures and “body language”, and multi-modal interaction fusing different interaction modalities. Human-robot coordination and collaboration include human-robot handovers, robotic assistants and co-workers. User interface design for mutual communications between robot and humans is covered, including social interaction. Several applications and scenarios will be included.

ME5311 Data-Driven Engineering and Machine Learning

The course covers basic linear algebra principles to provide the formalism to reveal coherent patterns and behaviors in data. We will introduce system identification methods, dimensionality reduction techniques, dynamical system theory, inverse problems in their Bayiesian form and machine learning techniques, with a special focus on neural networks. These will provide students with the necessary tools to analyze real-world datasets that are commonly found in practical engineering and scientific applications.

ME5418 Machine Learning in Robotics

The course provides the basics of machine learning, in terms of most commonly used techniques in robotics, including neural networks. The students will apply their learnt knowledge on a robotic task.