

### 1.6.1 Degree programmes and requirements

#### Master of Engineering and Doctor of Philosophy Degree (by Research)

MAE offers research programmes leading to the degrees of Doctor of Philosophy and Master of Engineering in all fields of mechanical and aerospace engineering. The ample state-of-the-art facilities and expertise support various areas of research to provide an incomparable learning experience. We also have on-going academic and research ties with eminent universities and institutes worldwide.

Candidates pursue an independent but supervised research in an approved field of advanced study based on which a thesis must be submitted. Candidates are also required to attend classes and pass the examinations in at least three to six courses. Candidates who are admitted will have to undergo a Qualifying Examination as well as a Confirmation Exercise. On completion of the research, the candidate is required to submit a thesis on his / her research for examination. For the degree of Doctor of Philosophy, there is also an examination on the course matter on his / her thesis and other related courses.

#### Strategic research programmes

The School of MAE offers a range of multidisciplinary strategic research programmes which focuses on developing leading-edge knowledge and technology of current and future promise and impact.

More information may be found at <http://www.ntu.edu.sg/mae/content.asp?mid=10> or <http://www.ntu.edu.sg/mae/content.asp?mid=17>

#### **Advanced Electronics and Manufacturing Processes**

- Advanced Materials Modelling and Processes
- Electronics Packaging
- Thin Film Technology

#### **Biomedical and Biomaterials Engineering**

- Biomedical Engineering
- Biomaterials Engineering
- Tissue Engineering

#### **Computational Engineering**

- Computational Materials
- Computational Mechanics
- Computational Fluid Dynamics

#### **Engineering Design and Modelling**

- Product Design, Intelligent Modelling and Realisation, Human Factors Engineering
- Engineering Computation and Modelling
- Virtual Reality and Soft Computing

#### **Intelligent Systems, Logistics and Engineering Management**

- Engineering Management and Logistics
- Intelligent Machines, Micromachines and Robots
- Vision, Control and Vehicle Technology

#### **Nanotechnology and Micro Systems**

- Micro Electro-Mechanical Systems (MEMS)
- Bio-Micro Electro-Mechanical Systems (Bio-MEMS)
- Precision Engineering
- Sensors and Actuators, Smart Materials and Structures

#### **Energy and Environmental Technology**

- Fuel Cell
- Environmental Technologies and Processes

#### **Aerospace Engineering**

- Aerodynamics, Boundary Layer and CFD
- Propulsion, Combustion and Turbomachinery

- Flight Guidance and Control
- Intelligent Materials and Adaptive Structures
- Surface Engineering

### **Master of Science Degree (by Coursework)**

All MAE M.Sc. students (except MEMS) are offered two options to complete the M.Sc. degree:

#### OPTION 1: Coursework and Dissertation

To complete eight courses and submit a Dissertation.

#### OPTION 2: Coursework Only

To complete ten courses; one of the two courses taken in lieu of the Dissertation must be the course entitled "Independent Study".

There are currently eight M.Sc. Programmes offered in the School of MAE:

### **Master of Science (Biomedical Engineering)**

This programme is specifically designed for graduate engineers, scientists, researchers, physicians and other related professionals with an interest to pursue a career in life sciences and health care. It is jointly offered by Nanyang Technological University and the Singapore General Hospital.

#### Courses of Study

Core courses:

M6511 Anatomy and Physiology  
M6514 Biomaterials\*  
M6503 Biomedical Instrumentation  
M6506 Clinical and Health Services Engineering

Four or five electives (depending on option of study selected) shall be selected from the following, of which at least two of the courses must be from Module A:

Electives (Module A):

M6522 Life Support Engineering  
M6525 Medical Informatics and Telemedicine  
M6532 Biomechanics & Rehabilitation Engineering\*  
DM6123 Scientific Visualisation

Electives (Module B):

M6134 Theory and Applications of Finite Element Analysis  
M6545 Computational and Clinical Biology  
M6601 Human Factors Engineering Fundamentals  
M6806 Engineering Research Methodology

*\* New course - pending approval*

### **Master of Science (Computer Integrated Manufacturing)**

Computer Integrated Manufacturing is the discipline in which different areas of manufacturing are organised into a structured and cohesive whole. The programme is tailored for practicing engineers, technology managers and information technologists employed in the manufacturing sector.

#### Courses of Study

Core Courses:

M6208 Foundations of Computer Integrated Manufacturing  
M6209 Management of Global Manufacturing Operations  
M6221 Networking and Databases  
M6401 Product Design and Development

Four or five electives (depending on option of study selected) shall be selected from the following, of which at least two of the courses must be from Module A:

Electives (Module A):

M6202 Systems Design  
M6205 Systems Simulation and Modelling  
M6226 Virtual Design and Manufacturing  
M6234 Advanced Manufacturing Systems  
M6301 Advanced Metrology and Sensing Systems  
M6421 Advanced Design for Manufacturing

Electives (Module B):

L6003 Corporate Resource Planning  
M6141 Quality Engineering  
M6232 Economics and Law for Global Manufacturing  
M6803 Computational Methods in Engineering

### **Master of Science (Human Factors Engineering)**

Human Factors Engineering deals with the design of systems that people use at work and in leisure and is designed for graduate engineers and designers.

#### Courses of Study

Core Courses:

M6601 Human Factors Engineering Fundamentals  
M6602 Interaction Design  
M6603 Human Factors Method  
M6604 Cognitive Ergonomics

Four or five electives (depending on option of study selected) shall be selected from the following, of which at least two of the courses must be from Module A:

Electives (Module A):

M6605 Experimental Design and Statistics  
M6607 Safety Engineering and Management

Electives (Module B):

M6202 Systems Design  
M6205 Systems Simulation and Modelling  
M6401 Product Design and Development  
M6525 Medical Informatics and Telemedicine  
M6426 Management Tech. and Innovation

### **Master of Science (Logistics)**

This programme is tailored for practising engineers, logisticians and information technologists employed in the procurement, manufacturing, warehousing transport and distribution sectors. It is offered jointly by the Centre for Engineering and Technology Management in the School of Mechanical and Aerospace Engineering and the Centre for Transportation Studies in the School of Civil and Environmental Engineering of NTU.

Courses of Study

Core Courses:

L6002 Quantitative Methods for Logistics Analysis  
L6003 Corporate Resource Planning  
L6004 Applications of Advanced Technologies in Logistics  
L6102 Procurement and Supplier Development

A total of four or five electives (depending on option of study selected) shall be selected from the following:

L6103 Supply Chain: Strategy and Design  
L6104 E-Supply Chains  
L6105 Demand Chain Analysis  
M6205 Systems Simulation and Modelling  
L6115 Management of Logistics Functions\*

\* *New course - pending approval*

**Master of Science (Mechanical Engineering)**

Breakthrough in many areas such as life sciences and micro/nanotechnologies is often seen to rely on the support of mechanical engineering. Thus, there is an increasing demand for R&D engineers and managers with a strong background in this area. This programme is specifically designed for graduate engineers, R&D engineers, scientists, researchers, and other related professionals who wish to equip themselves with more advanced knowledge in mechanical engineering to face the ever-changing world.

Courses of Study

Core Courses:

M6104 Advanced Mechanics of Materials  
M6801 Advanced Thermal Engineering  
M6802 Engineering Measurements

Five or six electives (depending on option of study selected) shall be selected from the following, of which at least one of the courses must be from Module A:

Electives (Module A)

M6134 Finite Element Analysis  
M6803 Computational Methods in Engineering

Electives (Module B)

L6103 Supply Chain Strategy and Design  
M6102 Advanced Materials Engineering  
M6202 Systems Design  
M6205 Systems Simulation and Modelling  
M6226 Virtual Design and Manufacturing  
M6234 Advanced Manufacturing Systems  
M6301 Advanced Metrology and Sensing System  
M6303 Fundamentals of Precision Engineering  
M6325 Advanced Electronic Packaging  
M6329 Micro Electro Mechanical Systems  
M6401 Product Design and Development  
M6402 Advanced Microprocessor Applications  
M6404 Advanced Mechanism Design  
M6426 Management of Technology Innovation  
M6429 Thermal Management in Product Design  
M6522 Life Support Engineering

M6806 Engineering Research Methodology

### **Master of Science (Mechanics and Processing of Materials)**

The design, processing and effective application of modern engineering materials contribute to the success of manufacturing industries worldwide and this programme is specifically designed for graduate engineers, materials engineers and scientists, and other related professionals to acquire an in-depth knowledge of the mechanics and processing of advanced engineering materials.

#### Courses of Study

Core Courses:

M6102 Advanced Engineering Materials  
M6106 Mechanics of Materials

A total of four or five electives (depending on option of study selected) shall be selected from the following:

Electives (Module A): Mechanics of Materials

M6104 Advanced Mechanics of Materials  
M6134 Theory and Applications of finite element analysis  
M6135 Failure Analysis and Prevention

Electives (Module B): Processing of Materials

M6143 Polymer Processing  
M6325 Advanced Electronic Packaging

Other Electives

M6141 Quality Engineering  
M6156 Advanced Characterisation Techniques  
M6301 Advanced Metrology and Sensing System  
M6303 Fundamentals of Precision Engineering  
L6003 Corporate Resource Planning

All Students must specialise in Mechanics of Materials or Processing of Materials. All students specialising in Mechanics of Materials must take at least two courses from Elective Module A and the remaining courses either from Elective Module B and/or Other Electives.

All students specialising in Processing of Materials must take at least two courses from Elective Module B and the remaining courses either from Elective Module A and/or Other Electives.

### **Master of Science (Precision Engineering)**

Precision engineering is cross-disciplinary, dealing with metrology, materials, micro-sensors and actuators, manufacturing methods, applications in medicine and many other relevant fields. The programme is specially designed for mechanical and manufacturing engineers, designers, research and development engineers, instructors at tertiary institutions, and other related professionals in industry to acquire an in-depth knowledge in precision engineering and other related topics.

#### Courses of Study

Core Courses:

M6102 Advanced Materials Engineering  
M6301 Advanced Metrology and Sensing Systems  
M6303 Fundamentals of Precision Engineering  
M6304 Ultra-precision and Micromachining Processes

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Four or five electives (depending on option of study selected) shall be selected from the following, of which at least three of the courses must be from Module A:

Electives (Module A)

M6141 Quality Engineering  
M6321 Precision Mechanism Design  
M6325 Advanced Electronic Packaging  
M6328 Optical Engineering  
M6329 Micro Electro Mechanical Systems

Electives (Module B)

M6802 Engineering Measurements  
M6221 Networking and Databases  
M6225 Concurrent Engineering  
M6226 Virtual Design and Manufacturing

**Master of Science (Smart Product Design)**

This programme is specifically designed for graduate engineers, designers, research and development engineers and other related professionals with the knowledge and expertise in product design, electronics and control, software engineering and manufacturing to design, develop and manufacture smart products. It addresses the need to design more reliable products that are of high quality at reduced manufacturing and societal costs.

Courses of Study

Core Courses:

M6401 Product Design and Development  
M6402 Advanced Microprocessor Applications  
M6403 Applied Mechatronics  
M6404 Advanced Mechanism Design

Four or five electives (depending on option of study selected) shall be selected from the following, of which at least two of the courses must be from Module A:

Electives (Module A)

EE6205 Real Time and Embedded Systems (from School of EEE, M.Sc. (CCA))  
M6421 Advanced Design for Manufacturing  
M6423 Prototype and Rapid Prototyping  
M6426 Management of Technology and Innovation  
M6429 Thermal Management in Product Design  
M6602 Interaction Design

Electives (Module B)

M6102 Advanced Materials Engineering  
M6141 Quality Engineering  
M6226 Virtual Design and Manufacturing  
M6303 Fundamentals of Precision Engineering  
M6321 Precision Mechanism Design  
M6601 Human Factors Engineering Fundamentals  
M6802 Engineering Measurements