

NTU Education (BRC) Course Listing

The following course content is for MAE students under the NTU Education (BRC).

The courses shown below do not reflect the offering status. As the curriculum will be reviewed on a yearly-basis, the course offerings are subject to the curriculum directions and availability of resources. Please refer to the pages that indicate the semester offerings.

(Offering in AY2018/2019 & AY2019/2020)

MA1008 Introduction to Computational Thinking

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Overview of Programming Languages; 2) Basic internal operation of computer; 3) Basic program structure; 4) CT concepts (Abstraction, Decomposition, Pattern recognition, Algorithm); 5) Limit of computing; 6) Computing trends; 7) Social-Ethical Issues and Ramifications of Computing

FE1073 An Introduction to Engineering and Practices

[Pre-requisites: Nil; Academic Unit: 1.0]

Content: **(Lab C1)** Resultants and equilibrium of forces; **(Lab C2)** Deformation of elastic body; **(Lab M1)** Work and energy; **(Lab M2)** Conservation of momentum; **(Lab E1)** Electric field; **(Lab E2)** Magnetic field; **(Seminar C1)** Introduction to Civil and Environmental Engineering; **(Seminar M1)** Introduction to Mechanical and Aerospace Engineering; **(Seminar E1)** Introduction to Electrical and Electronic Engineering.

HW0188 Engineering Communication I

[Co-requisites: HW0001; Academic Unit: 2.0]

Content: 1) Produce short academic prose relevant to the field; 2) Write an audience-specific short technical proposal/report; 3) Present key topics in engineering

HW0288 Engineering Communication II

[Pre-requisites: HW0188; Academic Unit: 2.0]

Content: 1) Apply various principles of technical writing to produce an effective FYP report; 2) Understand the communication demands of the contemporary workplace; 3) Make effective technical presentations, with reference to their FYPs and the workplace.

MH1810 Mathematics 1

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Complex numbers; 2) Vectors and matrices; 3) Limits and continuity of functions; 4) Derivatives; 5) Applications of derivatives; 6) Integration; 7) Integration methods; 8) Applications of integration.

MH1811 Mathematics 2

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Partial Differentiation; 2) Sequences and Series; 3) First Order Differential Equations; 4) Second Order Differential Equations.

MH2810 Mathematics A

This course is only applicable to Poly Direct Entry Students.

[Pre-requisite: Nil; Academic Unit: 4.0]

Content: 1) Complex numbers; 2) Vectors; 3) Functions and limits; 4) Differentiation; 5) Integration; 6) Sequences & Power Series; 7) Ordinary Differential Equations; 8) Partial Differentiation; 9) Multiple Integrals

PH1011 Physics

[Pre-requisites: A level physics; Academic Unit: 3.0]

Content: 1) Vectors; 2) Kinematics; 3) Forces and Torques; 4) Newton's Laws of Motion; 5) Impulse and Momentum 6) Work and Energy; 7) Thermal Physics; 8) Electric Field; 9) Magnetic Field; 10) Motion of Charged Particles and Applications; 11) Circuits.

PH1012 Physics A

This course is only applicable to Poly Direct Entry Students and JC students without A Level Physics.

[Pre-requisites: Basic trigonometry and calculus; Academic Unit: 4.0]

Content: 1) Vectors; 2) Kinematics 3) Forces and Torques; 4) Newton's Laws of Motion; 5) Impulse and Momentum; 6) Work and Energy; 7) Thermal Physics; 8) Electric Field; 9) Magnetic Field; 10) Motion of Charged Particles and Applications; 11) Circuits.

EG0001 Engineers & Society

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Pre-independence history of Singapore; 2) Social and political development issues; 3) Economic and industrial development issues; 4) National cohesion and total defence; 5) History of engineering; 6) Engineering ethics; 7) Engineering practice in Singapore (WSH and sustainability); 8) Our neighbours and international relations; 9) Challenges of globalization and the new economy; 10) Contribution of engineers in the new economy; 11) Impact of industry to the society

MA1001 Dynamics

[Pre-requisite: Having read PH1011/PH1012/CY1301/CY1308 and MH1810/MH2812/CY1201; Academic Unit: 3.0]

Content: 1) Kinematics of Particles; 2) Kinematics of Rigid Bodies; 3) Kinetics of Particles; 4) Kinetics of Rigid Bodies

MA1002 Fundamental Engineering Materials

[Pre-requisite: Nil; Academic Units: 3.0]

Content: 1) Materials building blocks; 2) Non-crystalline state of solids; 3) Crystalline state of solids; 4) Defects; 5) Mechanical behaviour of materials; 6) Failure; 7) Process and Applications; 8) Anisotropy of materials

MA1700 Aerospace Discovery Course

[Pre-requisites: Nil; Academic Unit: 1.0]

Content: Laboratories and design competition

MA1701 Introduction to Aerospace Engineering

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Aviation history and aircraft anatomy; 2) Introduction To Aerodynamics; 3) Introduction to Propulsion; 4) Flight Performance; 5) Stability & Control; 6) Introduction to Helicopters and Insights to space exploration; 7) Computing Skills; 8) Industry 4.0 and related state-of-the-art aerospace topics; 9) Introduction to Local Aerospace Engineering; 10) Introduction to Aerospace Structures & Materials.

MA2001 Mechanics of Materials

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction; 2) Stress And Strain; 3) Torsion; 4) Pure Bending; 5) Analysis and Design of Beams for Bending; 6) Shearing Stress in Beams, 7) Transformation of Stress and Strain, 8) Deflection of Beams, 9) Columns.

MA2002 Theory of Mechanism

[Pre-requisite: MA1001; Academic Unit: 3.0]

Content: 1) Fundamental Concepts of Mechanisms; 2) Gears and Gear Train; 3) Motion in Mechanisms: Kinematic Analysis; 4) Motion in Mechanisms: Static-Force Analysis; 5) Motion in Mechanisms: Dynamic-Force Analysis; 6) Design and Analysis of Cam-and-Follower Systems.

MA2003 Introduction to Thermo-fluids

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Basic Concepts and Properties of Pure Substances; 2) Energy and the first law of Thermodynamics; 3) Submerged surfaces and bodies; 4) Elementary fluid dynamics.

MA2004 Manufacturing Processes

[Pre-requisite: Nil; Academic Units: 3.0]

Content: 1) Overview of manufacturing and Introduction to Industry 4.0;
2) Dimensions and surfaces measurement; 3) Casting; 4) Shaping processes for polymers;
5) Sheet metalworking; 6) Materials removal processes; 7) Joining processes;
8) Microelectronics manufacturing.

MA2005 Engineering Graphics

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Orthographic projections; 2) Pictorial views and technical sketching; 3) Drawing standards and practices; 4) Sectional views and machine drawings; 5) Development of surfaces; 6) Dimensioning standards, systems and conventions; 7) Dimensioning features and finishes; 8) Tolerance dimensioning and limits; 9) Geometric dimensioning.

MA2006 Engineering Mathematics

[Pre-requisite: FE1006/MH1810 and FE1007/MH1811 or CY1201 and CY1203 or MA1003/MH2812; Academic Unit: 3.0]

Content: 1) Linear algebra; 2) Vector calculus; 3) Laplace transformation; 4) Fourier analysis.

MA2007 Thermodynamics

[Pre-requisite: MA2003; Academic Unit: 3.0]

Content: 1) Second law of Thermodynamics and entropy; 2) Entropy; 3) Refrigeration and Heat Pump Systems; 4) Analyses of Thermodynamic Cycles; 5) Non-reacting Gas Mixtures and Psychometrics;
6) Reacting Mixtures and Combustion

MA2009 Introduction to Electrical Circuits & Electronics Devices

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Analysis of Resistive Linear Networks; 2) Energy Storage Elements and Transient Analysis;
3) AC network analysis; 4) Operational Amplifiers and applications;
5) Basic semiconductor devices and applications; 6) Logic Circuits

MA2011 Mechatronics System Interfacing (Robotics & Mechatronics Stream only)

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Measurement system behavior; 2) Analog devices and measurement;
3) Digital devices and measurement; 4) Sensors; 5) Actuators; 6) Drives for motion control.

MA2012 Introduction to Mechatronics Systems Design (Robotics & Mechatronics Stream only)

[Pre-requisite: Nil; Academic Unit: 3]

Content: 1) Introduction to Mechatronics system; 2) Embedded Systems; 3) Sensors; 4) Actuators;
5) Interfacing to input and output devices; 6) Communication protocols; 7) Case study: Hexapod robot;
8) Review; 9) Project Work – Mechatronics System Project

MA2013 Creative Thinking and Design (Design Stream only)

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Fundamental Design; 2) Design Methods; 3) Creative Thinking

MA2014 Product Presentation (Design Stream only)

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Presentation Techniques; 2) Model-Making Methods.

MA0218 Introduction to Data Science and Artificial Intelligence [to be offered from AY2019/2020 S2]

[Pre-requisite: MA1008/FE1008/CY1402; Academic Unit: 3.0]

Content: 1) Data-Analytic Thinking; 2) The Data Pipeline; 3) Data Presentation;
4) Data-driven Inference; 5) Data-driven Identification; 6) Digital Storytelling;
7) Artificial Intelligence; 8) Reinforcement Learning and AI; 9) Ethics in DS&AI;
10) State-of-the-Art in DS&AI

MA2071 Laboratory Experiments (ME)

[Pre-requisite: Nil; Academic Unit: 1.0]

Content: Consists of 10 experiments related to Year 2 MAE core courses.

MA2072 Laboratory Experiments (AE)

[Pre-requisite: Nil; Academic Unit: 1.0]

Content: Consists of 10 experiments related to Year 2 MAE core courses.

MA2079 Engineering Innovation and Design

[Pre-requisite: Nil; Academic Unit: 2.0]

Content: 1) Introduction to Business planning, and Project management; 2) Practice in generating ideas and creative products, and technology and innovative engineering solutions through i-Project.

MA2700 Aerospace Materials & Manufacturing Processes

[Pre requisite: Nil; Academic Units: 3.0]

Content: 1) Introduction to Aerospace Materials; 2) Atomic Structures, Crystal Structures, Solidification; 3) Crystal Defects, Mechanical Properties, Deformation Mechanisms, Strengthening Mechanisms; 4) Failures of Aerospace Materials, Phase Diagrams; 5) Special Aerospace Materials; 6) Composites; 7) Manufacturing Processes; 8) Machining, Joining and Finishing Processes; 9) Industry 4.0

MA2701 Flight Performance

[Pre-requisite: MA1001 and MA1700; Academic Unit: 2.0]

Content: 1) Introduction to flight performance; 2) Atmosphere, Altitude and Flight Speed; 3) Review of Aerodynamics; 4) Review of Aircraft Propulsion; 5) Level Flight Performance; 6) Climb Performance; 7) Gliding Performance; 8) Level Turn Performance; 9) Pull-up and Pull-down Maneuver; 10) Takeoff Performance; 11) Landing Performance; 12) Range and Endurance; 13) Energy Methods in Accelerated Climb.

MA3001 Machine Element Design

[Pre-requisite: Having read MA2001 and MA2002; Academic Unit: 3.0]

Content: 1) Introduction; 2) Belt drives; 3) Chain drives; 4) Gear fundamentals, interference, speed ratio; 5) Design against failures; 6) Shaft design; 7) Key design, couplings, limits & fits; 8) Roller bearings; 9) Power screws & threaded fasteners, Bolted & welded joints; 10) Design of machine frames & parts.

MA3002 Solid Mechanics and Vibration

[Pre-requisite: MA2001; Academic Unit: 3.0]

Content: 1) Energy Method for Elastic Deformation; 2) Fracture Mechanics; 3) Fatigue 4) Vibration

MA3003 Heat Transfer

[Pre-requisite: MA2007; Academic Unit: 3.0]

Content:

1) Introduction to heat transfer. Heat transfer mechanism, Simultaneous heat transfer mechanisms;
2) Heat conduction equation in Cartesian coordinates, cylindrical & spherical coordinates. Boundary & initial conditions, formulation of heat conduction problems;
3) One dimensional steady state conduction across a plane wall & across radial systems. Conduction with heat generation: plane wall, solid cylinder;
4) Heat transfer from extended surfaces;
5) Transient conduction: lumped capacitance method;
6) Velocity and thermal boundary layers. Laminar and turbulent flow. The conservation equations. Dimensionless groups & their significance;
7) External forced convection. Laminar & turbulent flow over a flat plate;
8) Free convection;
9) Internal forced convection. Forced convection heat transfer in pipes;
10) Heat exchanger analysis, logarithmic mean temperature difference. Effectiveness-NTU method;
11) Blackbody radiation, View factors. Radiation exchange between multi-gray surfaces.

MA3004 Mathematical Methods in Engineering

[Pre-requisite: MH1810 and MH1811 or CY1203 or MH2812; Academic Unit: 3.0]

Content: 1) Partial Differential Equations (PDEs); 2) Finite Element Method (FEM); 3) Computational Fluid Dynamics (CFD).

MA3005 Control Theory

[Pre-requisite: Having read MA2006; Academic Unit: 3.0]

Content: 1) Introduction and Revision of Laplace Transform; 2) System Responses - transient and steady; 3) PID Controls; 4) Root Locus Technique; 5) Frequency Response Methods.

MA3006 Fluid Mechanics

[Pre-requisite: MA2003; Academic Unit: 3.0]

Content: 1) Momentum equation and its applications; 2) Dimensional analysis and similitude; 3) Internal flows and piping systems; 4) Principles and applications of fluid machines.

MA3010 Thermodynamics & Heat Transfer

[Pre-requisite: MA2003; Academic Unit: 3.0]

Content: 1) Second law of thermodynamics and entropy; 2) Non-reacting Gas Mixtures and Psychrometrics; 3) Conduction heat transfer; 4) Convection heat transfer; 5) Radiation.

MA3071 Engineering Experiments (ME)

[Academic Unit: 1.0]

Content: Consists of projects and experiments related to Year 3 MAE core courses.

MA3072 Engineering Experiments (AE)

[Academic Unit: 1.0]

Content: Consists of projects and experiments related to Year 3 MAE core courses.

MA3700 Aircraft Structures I

[Pre-requisites: MA2001; Academic Unit: 3.0]

Content: 1) Structural components of an aircraft; 2) Loads on aircraft; 3) Aircraft structural components and structural idealization; 4) Open and closed thin walled tubes; 5) Multicell structures; 6) Practical aircraft structural analysis; 7) Buckling Phenomenon.

MA3701 Aerodynamics

[Pre-requisite: (From AY2019: MA2003); Academic Unit: 3.0]

Content: 1) Introduction; 2) Potential flows; 3) Incompressible flows over airfoils; 4) Incompressible flows over finite wings; 5) Compressible flows; 6) Subsonic and transonic flows; 7) Supersonic flows; 8) Experimental Aerodynamics.

MA3702 Aircraft Propulsion

[Pre-requisite: MA2007; Academic Unit: 3.0]

Content: 1) Essentials of Thermodynamics; 2) Fundamentals of Aircraft Propulsion; 3) Propulsion Engines and Performance Analysis; 4) Combustors and Combustion; 5) Other Propulsion Engines.

MA3703 Flight Dynamics

[Pre-requisite: MA2701 and MA3705; Academic Unit: 2.0]

Content: 1) Introduction – Basic concepts of Flight Stability and Control; 2) Static Pitch Stability and Control; 3) Static Lateral-Directional Stability and Control; 4) Six degree-of-freedom body modeling of aircraft; 5) Linearization and linear system theory; 6) Linearisation of aircraft equations of motion; 7) Longitudinal Dynamics; 8) Longitudinal and lateral-directional dynamics; 9) Aircraft handling qualities.

MA3704 Aircraft Electrical Devices

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Aircraft Electrical Power Systems; 2) Electromagnetic Principles and Actuators; 3) Electrical Transformers; 4) Electrical Rotating Machines.

MA3705 Aerospace Control Theory

[Pre-requisite: Having read MA2006; Academic Unit: 3.0]

Content: 1) Introduction and Revision of Laplace Transform; 2) System Responses - transient and steady; 3) PID Controls; 4) Root Locus Technique; 5) Frequency Response Methods.

MA4001 Engineering Design (Mainstream only)

[Pre-requisite: Having read MA3001; Academic Unit: 4.0]

Content: 1) Product Definition; 2) Conceptual Design;
3) Embodiment Design; 4) Detailed Design and Engineering Analysis And Documentation;
5) Mechanical Power Transmission Systems; 6) Electric Motors And Linear Motion Systems;
7) Hydraulic And Pneumatic Systems; 8) Digital Control Techniques;
9) Introduction to Engineering Materials, Properties and Failure Modes;
10) Basics of materials selection and Case Studies; 11) Material Selection with Component Shape;
12) Compound Constraints & Multiple Objective Problems; 13) Cost estimation tools.

MA4002 Fluid Dynamics

[Pre-requisite: MA3006; Academic Unit: 3.0]

Content: 1) General Equations of Motion; 2) Potential Flow; 3) Isentropic Compressible Flow;
4) Non-isentropic Compressible Flow; 5) Boundary Layer Flow; 6) External Flow;
7) Turbomachines; 8) Unsteady Flow.

MA4011 Engineering Product Design (Design Stream only)

[Pre-requisite: Having read MA3001; Academic Unit: 4.0]

Content: 1) Product Definition; 2) Conceptual Design;
3) Embodiment Design; 4) Detailed Design and Engineering Analysis And Documentation;
5) Mechanical Power Transmission Systems; 6) Electric Motors And Linear Motion Systems;
7) Hydraulic And Pneumatic Systems; 8) Digital Control Techniques;
9) Introduction to Engineering Materials, Properties and Failure Modes;
10) Basics of materials selection and Case Studies; 11) Material Selection with Component Shape;
12) Compound Constraints & Multiple Objective Problems; 13) Cost estimation tools.

MA4012 Mechatronics Engineering Design (Robotics & Mechatronics Stream only)

[Pre-requisite: Having read MA3001; Academic Unit: 4.0]

Content: 1) Product Definition; 2) Conceptual Design;
3) Embodiment Design; 4) Detailed Design and Engineering Analysis And Documentation;
5) Mechanical Power Transmission Systems; 6) Electric Motors And Linear Motion Systems;
7) Hydraulic And Pneumatic Systems; 8) Digital Control Techniques;
9) Introduction to Engineering Materials, Properties and Failure Modes;
10) Basics of materials selection and Case Studies; 11) Material Selection with Component Shape;
12) Compound Constraints & Multiple Objective Problems; 13) Cost estimation tools.

MA4701 Aircraft Design

[Pre-requisites: MA3701, MA3702, and MA3703, Academic Units: 3.0]

Content: 1) Introduction and Overview of the Aircraft Design Process; 2) Cost Analysis;
3) Initial Design Estimates and Configuration Layout;
4) Review (Aerodynamics, Aerostructures, Aircraft Performance and Flight Mechanics);
5) Airworthiness, Certification and Environmental Considerations;
6) Propulsion and Aircraft System Integration; 7) Material Requirements and Selection;
8) Workshop/Special Design Considerations

MA4702 Aircraft Structures II

[Pre-requisites: MA2001, MA3700; Academic Unit: 3.0]

Content: 1) Introduction to Finite Element Method (FEM);
2) Development of 1-D and 2-D Solid Finite Elements;
3) Aerospace Applications of the FEM;
4) Fundamentals Of Vibration;
5) Vibration Of Multiple Degrees Of Freedom Systems and Continuous Systems;
6) Vibration Measurement And Control.

MA4704 Aeroelasticity

[Pre-requisite: MA3700 and MA3701; Academic Unit: 3.0]

Content: 1) Introduction to Aeroelasticity; 2) Structural Dynamics; 3) Unsteady Aerodynamics; 4) Static Aeroelasticity; 5) Flutter.

MA4705 Aircraft Navigation and Flight Computers

[Pre-requisite: MH1811/FE1007/CY1203/CY1602/MH2812/MH2810; Academic Unit: 3.0]

Content: 1) Introduction to Signal and Processes; 2) Basics of Navigation Data Processing; 3) Radio Navigation; 4) Inertial Navigation; 5) Fundamentals and Trends of Flight Computers.

MA4803 Noise and Vibration Control

[Pre-requisite: (From AY2019: MA1001); Academic Unit: 3.0]

Content: 1) Fundamentals of Mechanical Vibrations; 2) Practical Examples of Damping and Vibration Control; 3) Principles of Vibration Control; 4) One-Dimensional Acoustic Waves; 5) Acoustic Transmission Phenomenon; 6) Human Response to Noise and Measurement of Noise; 7) Noise Control.

MA4804 Optimisation Theory and Applications

[Pre-requisite: MH1810/CY1201/MH2810; Academic Unit: 3.0]

Content: 1) Introduction to Optimization; 2) Fundamental Concepts in Optimization; 3) Categorization of Optimization Problems and Methods; 4) Non-Linear Programming; 5) Discrete Optimization; 6) Linear Optimization; 7) Multi-Objective Optimization; 8) Other Categories of Optimization Problems; 9) Overview of Numerical Optimization Methods; 10) Optimization in Practice.

MA4807 Marine Structural Integrity

[Pre-requisite: MA2001; Academic Unit: 3.0]

Content: 1) Introduction to Marine Structural Integrity; 2) Loads and its Effects on Marine Structures; 3) Bending and buckling of beam and plate structures; 4) Introduction to Fracture and Fatigue; 5) Fracture analysis; 6) Fatigue analysis; 7) Structural Integrity Design of welded structures

MA4808 Marine Control Systems

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Electrical Machines and Electrical Power Systems; 2) Fluid Power Control; 3) Pumps and Piping Systems; 4) Automation & Control in Marine Engineering Systems.

MA4811 Psychrometry and Air Conditioning

[Pre-requisite: MA3003; Academic Unit: 3.0]

Content: 1) Air-conditioning systems and applications; 2) Solar Radiation and Windows; 3) Heat transmission in building structures and Cooling Load; 3) Psychrometrics, Comfort and Health; 5) Cooling Equipment; 6) Air Distribution Systems and Design; 7) Chilled water distribution systems; 8) Cooling Systems Design Sizing and Energy Calculations; 9) Computer-Aided Load Sizing of Air-Conditioning System.

MA4813 Building Services Engineering

[Pre-requisites: MA3003; Academic Unit: 3.0]

Content: 1) Vertical Transportation Systems; 2) Potable and Waste Water Systems; 3) Basic Fire Science; 4) Compartment Fire and Fundamentals of Fire Suppression; 5) Fire Fighting Systems in Buildings; 6) Smoke Control in Buildings

MA4814 Computational Fluid Dynamics

[Pre-requisites: MA3006 and MH1811/CY1203/MH2812/MH2810; Academic Units: 3.0]

Content: 1) Introduction to computational fluid dynamics; 2) Classification of Partial Differential Equations; 3) The Finite Volume Method; 4) Stability Analysis; 5) Navier Stokes; 6) Turbulence Models; 7) Computational Fluid Dynamics Laboratory Experiments.

MA4822 Measurements and Sensing Systems (Robotics & Mechatronics Stream only)

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Basic concepts of Measurement and Sensing; 2) Measurement and Sensing in Electrical Systems; 3) Measurement and Sensing in Mechanical Systems; 4) Measuring and Sensing in Environmental Systems; 5) Measurement and Sensing in Fluid Systems; 6) Measurement and Sensing in Perception Systems; 7) Data Processing in Measurement and Sensing Systems.

MA4825 Robotics (Robotics & Mechatronics Stream only)

[Pre-requisite: (From AY2019: MA3001 & MA3005); Academic Unit: 3.0]

Content: 1) Robot's Mechanical Systems and Design; 2) Robot's Motion Planning Systems and Design; 3) Robot's Motion Control Systems and Design; 4) Robot's Kinematics; 5) Robot's Dynamics

MA4829 Machine Intelligence [to be offered from AY2019/2020 S2]

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Artificial Intelligence and Logics; 2) Data Mining; 3) Decision-making; 4) Visual Data Acquisition; 5) Visual Data Processing; 6) Perception of 2D Geometry; 7) Perception of 3D Geometry

MA4830 Realtime Software for Mechatronic Systems (Robotics & Mechatronics Stream only)

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Review of Foundation C; 2) Advanced C Techniques; 3) Fundamentals of Real-time Systems; 4) Commercial Operating Systems; 5) Program Interface Expansion Cards

MA4831 Computer-aided Engineering

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction; 2) Computer graphics; 3) Computer-aided design; 4) Dynamic analysis; 5) Computer-aided manufacturing; 6) Virtual & Augmented Reality in Design, Manufacturing and Engineering; 7) Project Work

MA4832 Microprocessor Systems (Robotics & Mechatronics Stream only)

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Basics of Microprocessors; 2) Assembly Programming; 3) Number Systems;

4) Interfacing, Input and Output Devices I –

Interfacing to semiconductor devices, Basic principles of opto-electronic devices. Interfacing to opto-electronic, display sensors and memory devices. Logic circuit characteristics. Use for timers and pulse-width modulation signals.

5) Interfacing, Input and Output Devices II –

Communication protocols to sensors and semiconductor devices. Communication status and errors. Register Maps and bit descriptions. Functions, features and implementation of Timers and Counters. Nested Vector Interrupts and priority settings of various microprocessor functions.

MA4837 Net Shape Manufacturing

[Pre-requisite: MA2004 or RE1006; Academic Unit: 3.0]

Content: 1) Advanced metal casting; 2) Powder metallurgy; 3) Powder shaping and full density processes; 4) Bulk deformation processes; 5) Sheet metal forming processes; 6) Plastics shaping processes; 7) New and emerging technologies.

MA4838 Non-conventional Manufacturing Processes

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction to Non-conventional Manufacturing Processes; 2) Mechanical Energy-Based Removing; 3) Deposition of Thin Films (PVD); 4) Plasma Machining (Dry Etching); 5) Non-conventional chemical manufacturing; 6) Nano-manufacturing; 7) Thermal Processes; 8) Hybrid Processes.

MA4842 Engineering Metrology

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction to Metrology and Measurement; 2) Mechanical Metrology; 3) Surface Metrology; 4) Coordinate Measurement; 5) Laser and Optical Metrology; 6) Laboratory Sessions

MA4843 Management of Product Development (Design Stream only)

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Management of Innovation; 2) New Product Development; 3) Prototypes; 4) Strategy for New Product Development; 5) Organising and Leading Product Development Teams; 6) Case Studies

MA4845 Manufacturing Automation

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Types of Manufacturing Automation; 2) Additive Manufacturing Process and Systems; 3) Additive Manufacturing Design and Applications; 4) Introduction to Automatic Assembly

MA4846 Product Design Engineering (Design Stream only)

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction; 2) Plastic materials and properties; 3) Design guidelines for cost-effective plastic part design; 4) Joining and assembly of plastic parts; 5) Decorating plastic parts; 6) Concurrent Engineering; 7) Quality Function Deployment; 8) Design for Manufacture & Assembly (DFMA) – DFM; 9) Design for Manufacture & Assembly (DFMA) – DFA; 10) Design for waste minimization/dematerialization. Eco-labelling; 11) Design for disassembly; 12) Design for remanufacturing; 13) Design for recycling; 14) Life-cycle Assessment; 15) Product-Service Systems

MA4849 Operations Research

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Fundamentals of Probability Theory; 2) Probability Distributions; 3) Limit Theorems; 4) News Vendor Models; 5) Linear Programming; 6) Integer Programming; 7) Decision Analysis; 8) Network Optimization and Applications

MA4850 Supply Chain and Logistics Management

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction to Supply Chain Management, issues and challenges in SCM, the cost of logistics, and the importance of SCM and logistics; 2) Demand forecasting, time-series and causal models, forecasting techniques that include moving average, exponential smoothing, linear and non-linear regression etc.; 3) Inventory management, EOQ and Newsvendor models, Periodically reviewed and continuously reviewed models, inventory accounting and management; 4) Supply chain and Logistics network design, Warehousing and Transportation Management, supply chain contracting; 5) Integrated product and supply chain design; Global supply chains, information technology, supply chain risk management.

MA4853 Manufacturing Systems

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction & Case Study; 2) Inventory Control; 3) Material Requirement Planning (MRP); 4) Just-in-Time (JIT); 5) Forecasting Methods; 6) Aggregate Planning; 7) Scheduling

MA4854 Quality Assurance and Management

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction to Quality Assurance and Management; 2) Statistics Process Control (SPC); 3) Design of Experiment (DOE); 4) Reliability; 5) Quality Standards

MA4856 Naval Architecture and Marine Engineering

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Ship Layout & Stability; 2) Ship Structural Strength; 3) Ship Resistance; 4) Ship Propulsion; 5) Marine Power Plants; 6) Advanced Power Plant Technologies; 7) Ship Service Systems.

MA4858 Product Design (Design Stream only)

[Pre-requisite: MA2014 Product Presentation & MA2013 Creative Thinking and Design; Academic Unit: 3.0]

Content: 1) Introduction to Product Design; 2) Principles of user centric design approach, exploration techniques of user experience; 3) Research methods in product design, surveys, analysis and presentation of results; 4) The consideration and application of emerging technologies

MA4870 Mechanics of Composite Materials

[Pre-requisite: MA2001; Academic Unit: 3.0]

Content: 1) Introduction to Composite Materials; 2) Mechanics of Components I; 3) Mechanics of Components II; 4) Analysis of Laminated Plates; 5) Design of Composite Structures.

MA4871 Non-Destructive Testing

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Overview of NDT; 2) Ultrasonic and Eddy Current methods; 3) Other traditional NDT Methods (Fluid penetrant, Magnetic particle, X-ray, Thermography); 4) Optical Methods (Visual inspection, Shearography, Holography and Speckle, Fiber Optic Sensors for health monitoring)

MA4872 Aircraft Reliability and Maintainability

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction to Maintenance, Repair and Overhaul; 2) Reliability; 3) Maintainability; 4) Availability; 5) Data Collection and Analysis; 6) Management; 7) Safety.

MA4873 Intermediate Aerodynamics

[Pre-requisite: MA3701; Academic Unit: 3.0]

Content: 1) Introduction; 2) Navier-Stokes Equations; 3) Ideal Aerodynamics; 4) Panel Methods; 5) Boundary Layers; 6) Unsteady Aerodynamics; 7) Applied and Industrial Aerodynamics.

MA4878 Unmanned Aerial Vehicles

[Pre-requisite: MA3701 and MA3703; Academic Unit: 3.0]

Content: 1) Introduction and Overview of UAV systems; 2) UAV Aerodynamics; 3) UAV Performance and Propulsion; 4) Flight Stability, Dynamics and Control; 5) Introduction to Multi-Copters; 6) Autopilots Design; 7) Autonomous Multi-copters; 8) Cooperative Control and Multi UAVs; 9) Introduction and challenges to Multi UAVs.

MA4880 Airport Operations and Systems

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction to Airport as a System;
2) Airport Master Planning and Forecasting;
3) Airfield Design: Runways and Taxiways;
4) Airport Obstruction Analysis;
5) Airport Tower Siting Requirements;
6) Airport Terminal Design;
7) Airport Air Traffic Control (Approach, Tower and Ground);
8) Airport Navigation Aids (DME, VOR, ILS, PAPI, VASI, RAILS);
9) Airport Weather Systems (TAF and METAR);
10) Airport Environmental Impact (Aviation Noise);
11) Airport Capacity Modelling;
12) Airport Delay Modelling.

MA4881 Air Traffic Management [to be offered from AY2019/2020 S1]

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction to Air Traffic Management; 2) Airspace Structures and ATC Procedures; 3) Air Traffic Communication Systems and Procedures; 4) Air Navigation System and Procedures; 5) Air Traffic Surveillance Systems; 6) Airspace Operations in Singapore; 7) Airport Operations; 8) ATC Tower Operations; Weather and ATM; 9) Environmental Impact of ATM; 10) Human Factors in ATM; 11) Advanced ATM Concepts

MA8005 Aircraft Electrical and Electronics Circuits

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Analysis of Resistive Linear Networks; 2) Energy Storage Elements and Transient Analysis; 3) AC network analysis; 4) Operational Amplifiers and applications; 5) Basic semiconductor devices and applications; 6) Logic Circuits

MA8103 Human Resource Management

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Introduction to Strategic Human Resource Management; 2) Human Resource Planning; 3) Job Analysis and Job Design; 4) Recruitment and Selection; 5) Employee Compensation and Benefits; 6) Performance Appraisal and Management; 7) Career Development and Management; 8) Managing Diversity; 9) Industrial Relations; Employee Health and Safety; 10) International Human Resource Management; 11) Human Resource Development; 12) Assessing HRM effectiveness; 13) Legal Perspective of HRM

MA8105 Engineering Management Analysis

[Pre-requisite: Nil; Academic Unit: 3.0]

Content: 1) Principles of engineering economy as a basis for engineering management. Basic relationships in the time value of money, factor analysis; 2) Engineering management techniques, including nominal and effective interest rates, present and annual worth analysis, rate of return analysis, etc; 3) Applications in project benefit & cost analysis, project financing, capital goods replacement and retention analysis, breakeven and payback analysis; 4) Macro topics including inflation and tax, decision making and risk analysis.

MA9004 Systems Thinking and Systems Engineering [to be offered from AY2019/2020 S1]

[Pre-requisites: Nil; Academic Units: 3.0]

Content: 1) Systems Thinking and Methodologies; 2) Introduction to Systems Engineering; 3) Stakeholders' Needs and Requirements; 4) Systems Requirements; 5) System Architecture; 6) SE Business Drivers and Challenges; 7) SNR Practices; 8) Functional and Non-Functional Requirements: Capabilities and Quality Attributes; 9) Architecting and Strategy; 10) Special Topic: A Systems Perspective of Industry 4.0; 11) Case Studies, Seminar Presentation of Written Assignments.

MA9030 Bioprinting: Principles and Applications

[Pre-requisites: Nil; Academic Units: 3.0]

Content: 1) Introduction to Tissue Engineering; 2) Scaffolds for Tissue Engineering; 3) Cell Sources for Bioprinting; 4) 3D Cell Culture Techniques; 5) Bioprinting Techniques; 6) Materials for Bioprinting; 7) Computational Design; 8) Workshop exposure to bioprinters

MA9031 3D Printing and Additive Manufacturing – Principles and Applications *[only offered for GEM Trailblazer Summer programme]*

[Pre-requisites: Nil; Academic Units: 3.0]

Content: 1) Introduction; 2) Process Chain; 3) Liquid Based 3D Printing Systems;
4) Solid Based 3D Printing Systems; 5) Powder Based 3D Printing Systems; 6) STL File Format;
7) Applications and Case Studies; 8) Benchmarking, Growth and Trends

MA9032 Standards and Laser in 3D Printing *[only offered for GEM Trailblazer Summer programme]*

[Pre-requisites: Nil; Academic Units: 3.0]

Content: Introduction to 3D printing; Standards and Measurement Sciences Roadmap; Data Format Standard and Process Monitoring; Material characterization; Equipment qualifications; Benchmarking; Intro to Lasers and Basic Optics for 3D Printing and Manufacturing; Materials for Laser-based 3D Printing and Manufacturing; One-, Two-, and Three-Dimensional Laser Assisted Manufacturing; Laser-based 3D Printing; Advanced 3D Manufacturing: Micro and Nanoscale Patterning; Future prospects & Laser Safety

MA9034 Managing Complex Systems Projects *[only offered for GEM Trailblazer Summer programme]*

[Pre-requisites: Nil; Academic Units: 3.0]

Content: 1) What are Complex Systems Projects?;
2) Systems Thinking in Complex Systems Projects;
3) Coping & Driving CSPs;
4) Sources & Types of Project Complexity;
5) Guide to Tools for managing Complexity;
6) Managing Large Infrastructure Projects;
7) Complex Social-technical Systems;
8) Systems Engineering Paradigm & Practices;
9) Application of Systems Engineering in Large Infrastructure Projects;
10) Application of Systems Engineering in Large-scale Systems;
11) Project Management Strategies for Complex Projects;
12) Lean Enablers for Managing Complex Engineering Programs;
13) Students' Presentation of Written Assignments.