

## 1.6.2 Description of courses

### Year 2

#### **MP0001 Essential Mathematics**

AUs: 2, Prerequisites: NIL, Semester: 1

Functions and Derivatives. Integration. Complex numbers and Vectors. Power Series. Multivariable Functions and Partial Derivatives. Ordinary Differential Equations.

#### **MP2001 Mechanics of Materials**

AUs: 3, Prerequisites: FE1001, Semesters 1 and 2

Review of concepts of equilibrium and free body diagram. Stress and strain. Torsion. Bending stresses in beams. Shearing stresses in beams. Transformation of stress and strain. Yield and fracture criteria. Deflection of beams. Columns.

#### **MP2002 Kinematics and Dynamics of Machinery**

AUs: 3, Prerequisites: FE1001, Semesters 1 and 2

Kinematic Fundamentals. Kinematics of Linkages. Static Force Analysis of Mechanisms. Dynamic Force Analysis of Mechanisms. Spur Gears and Gear Trains. Cams.

#### **MP2003 (for Mainstream only) Thermodynamics**

AUs: 4, Prerequisites: NIL, Semesters 1 and 2

Properties of pure substances. Work and heat. Energy and the first law. Energy balance for closed systems and steady state control volumes. Second law and entropy. Entropy balance for closed systems and steady state control volumes. Thermodynamic cycles for power plants and refrigeration systems. Ideal gas mixtures and psychrometrics. Reacting mixtures and combustion.

#### **MP2004 (for Mainstream and Mechatronics Stream only) Manufacturing Technology and Materials**

AUs: 4, Prerequisites: NIL, Semesters 1 and 2

Ferrous alloys. Nonferrous metals and alloys. Polymers: Structure and general properties. Ceramics and glasses. Introduction to composites. Casting. Sheet-metal forming processes. Plastics forming processes. Material removal processes. Joining processes. Electronics Manufacturing Technology. Engineering Metrology.

#### **MP2005 Fluid Mechanics**

AUs: 4, Prerequisites: NIL, Semesters 1 and 2

Submerged surfaces and bodies. Elementary fluid dynamics. Momentum equation and its application. Dimensional analysis and similitude. Internal flows and piping systems. Principles and applications of fluid machines.

#### **MP2006 Mathematics 3**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Probability and Statistics. Matrix Analysis/Linear Algebra. Vector Differential Calculus. Vector Integral Calculus.

#### **MP2007 Mathematics 4**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Complex Variables. Fourier Analysis. Laplace Transform. Partial Differential Equations.

#### **MP2008 Electrical and Electronics: Circuits and Devices**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Resistive circuits and circuit theorems, Energy storage elements and transient response, AC circuits, Diode circuit analysis, Bipolar junction transistors, Small-signal BJT amplifiers, MOSFET and small-signal MOSFET amplifiers, Transistor Switches, Operational amplifiers, Logic gates.

#### **HW210 Technical Communication**

AUs: 2, Prerequisites: NIL, Semesters 1 and 2

The content of the syllabus is taught through project work. The project-based learning approach is used throughout to ensure active participation in the process of learning technical communication.

#### **MP2010 (for Design and Mechatronics Stream only) Thermodynamics and Heat Transfer**

AUs: 4, Prerequisites: NIL, Semester 1

Properties of pure substances. Work and heat. First law for closed systems and control volumes. Second law and entropy. Vapour power cycles and gas turbine plants. Refrigeration and heat pump systems. Conduction: formulation of heat conduction problems, one dimensional problems, conduction with heat generation, fin and lumped

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capacitance analysis. Convection: conservation transfer equations, flow over flat plate, forced convection in pipes, forced convection correlations, free convection correlations. Heat exchanger analysis. Radiation: black body radiation exchange, gray surface and a large enclosure.

**MP2011 Engineering Graphics and Machine Components**

AUs: 4, Prerequisites: MP2001, Semester 2

Orthographic projections. Pictorial views and technical sketching. Drawing standards and practices. Sectional views and machine drawings. Development of surfaces. Power transmission components. Dimensions and tolerances, surface finish. Bearings. Threaded fasteners, power screw, joints.

**MP2012 (for Design Stream only) Creative Thinking and Design**

AUs: 3, Prerequisites: NIL, Semester 1

Creative and visual thinking. Generation of ideas. Problem solving. Introduction to design process. Design elements and principles. Product presentation. Development of design. Visual design. Virtues of design. Mini projects.

**MP2013 (for Mechatronics Stream only) Mechatronics System Interfacing**

AUs: 3, Prerequisites: NIL, Semester 2

Measurement system behaviour. Analog devices and measurement. Digital devices and measurement. Sensors. Actuators. Drives for motion control.

**MP2071 Laboratory 2A**

AU: 1, Prerequisites: NIL, Semesters 1 and 2

Laboratory experiments and projects to provide practical application and understanding of theories relating to second year courses in Mechanical and Aerospace Engineering.

**MP2072 Laboratory 2B**

AU: 1, Prerequisites: NIL, Semesters 1 and 2

Laboratory experiments and projects to provide practical application and understanding of theories relating to second year courses in Mechanical and Production Engineering.

**MP2079 Engineering Innovation and Design**

AUs: 2, Prerequisites: NIL, Special Term I

Computer Aided Design and Engineering. Design for assembly. Innovative product design. Design modelling. Engineering analysis. Appreciation of manufacturing processes. Pneumatic control. Mechatronics design and assembly. Material selection. Introduction to Business planning, and Project management. Practice in generating creative products, technology and innovative engineering solutions through T21 project.

**Year 3**

**MP3001 (for Mainstream and Mechatronics Stream only) Dynamics and Control**

AUs: 4, Prerequisites: MP2007, Semesters 1 and 2

Modelling of linear systems. Dynamics response analysis. Theory of linear feedback control systems. Time and frequency domain design techniques. Performance and stability analysis.

**MP3002 (for Mainstream and Mechatronics Stream only) Mechanics of Deformable Solids**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Response of single degree of freedom systems to harmonic, impulse and arbitrary excitation. Forced harmonic excitation of 2-DOF systems. Normal mode summation for systems with several degrees of freedom systems. Stationary energy methods. Theory of plane and axisymmetric elasticity.

**MP3003 (for Mainstream only) Heat Transfer**

AUs: 3, Prerequisites: MP2003, Semesters 1 and 2

Conduction: formulation of heat conduction problems, one dimensional problems, conduction with heat generation, fin and general lumped capacitance analysis. Convection: conservation transfer equations, dimensional analysis, flow over flat plate, forced convection in pipes, forced convection correlations, free convection correlations. Heat exchanger analysis. Radiation: black body radiation exchange, radiation exchange between multi-gray surfaces.

**MP3004 (for Design Stream only) Concurrent Design and Engineering**

AUs: 3, Prerequisites: NIL, Semester 1

Overview of DFX philosophy. DFM Principles and Strategies. DFA Guidelines. Assembly Strategies. Design for the Environment. Design for Safety. Concurrent Engineering.

**MP3005 (for Design Stream only) Computer-aided Design**

AUs: 3, Prerequisites: NIL, Semester 1

Introduction. Overview. Historical perspective. Computer graphics. Computer-aided design. Interface to applications.

**MP3006 (for Mechatronics Stream only) Microprocessor Systems**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Fundamental of microprocessor architecture. Concepts and techniques of memory organisation, stacks and the use of interrupts. Data representation and operation. Programming. Timers and I/O operations. Basic and display electronics. Interfacing to digital devices.

**MP3007 (for Mechatronics Stream Only) Real-time Software for Mechatronics Systems**

AUs: 3, Prerequisites: NIL, Semester 1

Review of Foundation and Advanced ANSI C and POSIX Realtime extensions. Embedded Microcontroller Systems. Fundamentals of Real Time Systems. Commercial Operating Systems. Software System Design.

**MP3010 (for Design Stream only) Engineering Product Design**

AUs: 4, Prerequisites: MP2911 or MP2011, Semester 1

Brakes and Clutches, Couplings, Hydraulic Power transmission, Electrical Control of Hydraulic Circuits, Electric Motors, Machine Frame Design, The Design Process: Product idea and Design Specification. Conceptual Design. Embodiment and Detailed Design. Plastic Part Design. Injection Mould Design.

**MP3011 (for Mainstream and Mechatronics Stream only) Engineering Design**

AUs: 3, Prerequisites: MP2011, Semesters 1 and 2

Brakes and clutches. Couplings. Hydraulic power transmission. Electrical control of hydraulic circuits. Electric motors. Machine frame design. The design process: product idea and design specification. Conceptual design. Embodiment and detailed design.

**MP3071 (for Mainstream and Design Stream only) Laboratory 3**

AUs: 2, Prerequisites: NIL, Semesters 1 and 2

Experiments and mini-project involving design, construction and testing related to Dynamics and Control (MP3001), Mechanics of Deformable Solids (MP3002/MP4102), Heat Transfer (MP3003), Manufacturing Technology and Materials (MP3104) and Engineering Design (MP3011).

**MP3072 (for Mechatronics Stream only) Laboratory 4**

AUs: 1, Prerequisites: NIL, Semester 1

Experiments and mini-project involving design, construction and testing related to Dynamics and Control (MP3001), Mechanics of Deformable Solids (MP3002) and Engineering Design (MP3011).

**MP3079 Industrial Attachment**

AUs: 10, Prerequisites: Promoted to Year 3, Semesters 1 and 2

Through a 22-week industrial attachment, students can expect to gain first-hand knowledge of day-to-day operations in the Mechanical Engineering profession; apply the acquired knowledge and skills in actual planning, design, production, construction and/or operation/maintenance practices; and become knowledgeable in field problems and requirements of the industry.

**MP3104 (for Design Stream only) Manufacturing Technology and Materials**

AUs: 4, Prerequisites: NIL, Semesters 1 and 2

Ferrous alloys. Nonferrous metals and alloys. Polymers: Structure and general properties. Ceramics and glasses. Introduction to composites. Casting. Sheet-metal forming processes. Plastics forming processes. Material removal processes. Joining processes. Electronics Manufacturing Technology. Engineering Metrology.

**Year 4**

**MP4001 (for Design Stream Only) Quality Assurance and Management**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Fundamental concepts. Acceptance sampling and control charts. Design of experiments. Reliability engineering. Total quality management. ISO 9000 series quality management systems. Environmental management systems.

**MP4002 (for Design Stream only) Human Factors in Design**

AUs: 3, Prerequisites: NIL, Semester 1

Introduction to human factors. Physical ergonomics. Cognitive ergonomics. Human-computer interaction. Human factors of product design. Socio-technical aspects of human factors in design.

**MP4003 (for Design Stream only) Strategic Management of Product Development**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

The course covers topics on critical product development considerations and competition strategies, the role of prototyping in product design and manufacturing, the organisation and management of cross functional product development teams, the capture and modelling of customer needs, risk assessment and management, the role of R & D, and the strategies for achieving fast cycle competition and time to market. The teaching approach of a graduate management course will be used, with equal emphasis on lectures, and case analysis and presentation by students.

**MP4004 Advanced Manufacturing and Nanotechnology (for Mainstream only)**

AUs: 3, Prerequisites: MP2004, Semesters 1 and 2

Lithography, Etching and Additive Techniques. Advanced Metrology. Overview of Nanotechnology. Nanometrology. Emerging Techniques in Nanomanufacturing.

**MP4005 (for Mainstream only) Fluid Dynamics**

AUs: 3, Prerequisites: MP2003 and MP2005, Semesters 1 and 2

General equations of motion. Potential flow. Isentropic compressible flow. Normal shocks, Fanno and Rayleigh line flows. Boundary layer flow. External flow. Performance characteristics of pumps and turbines. Unsteady flow and surge control.

**MP4006 (for Mechatronics Stream only) Robotics**

AUs: 3, Prerequisites: NIL, Semester 1

Introduction to robotics. Robot actuators and sensing systems. Fundamentals of rigid body motion. Kinematics of robot manipulators. Motion planning and programming. Dynamics and control of robot manipulators. Robotics design and applications.

**MP4007 Engineers and Society**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Our country. Engineers in society. Our world in the new Millennium.

**MP4008 Human Resource Management**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

The Nature of Human Relations. The Study of Individual Behavior. Behavior of Groups and Productivity Practices. Managing Technological Change. Managing in Knowledge-based Futures. Fundamentals of Leadership. HRM Skills of a Leader: Developing, Appraising and Rewarding Staff. Managing Performance: Corporate, Group and Individual. Productivity Innovation, Creativity and Inventive Culture. Internationalisation and HRM. Managing Industrial Relations. Personal Career Development. Topical HRM Issues.

**HW310 Professional Communication**

AUs: 2, Prerequisites: HW001 or FE0009, Semesters 1 and 2

Introduction. Communication process. Writing process. Memo and memo reports. Business correspondence. Interpersonal skills. Meetings. Agenda and minutes. Negotiations. Job search. Proposals. Oral presentation. Intercultural. Revision.

**MP4010 (for Mechatronics Stream only) Mechatronics Systems Design and Analysis**

AUs: 4, Prerequisites: MP3011, Semester 2

Design issues. Cost engineering. Drive system design. Digital control techniques. Basic concepts of the finite element method. Two-dimensional problems. Finite element procedures and applications. Seminars.

**MP4011 (for Mainstream and Design Stream only) Mechanical System Design and Analysis**

AUs: 3, Prerequisites: MP3010 or MP3011, Semesters 1 and 2

Design issues. Cost engineering. Drive system design. Digital control techniques. Basic concepts of the finite element method. 2-D problems. Finite element procedures and applications.

**MP4102 (for Design Stream only) Mechanics of Deformable Solids**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Response of single degree of freedom systems to harmonic, impulse and arbitrary excitation. Forced harmonic excitation of 2-DOF systems. Normal mode summation for systems with several degrees of freedom systems. Stationary energy methods. Theory of plane and axisymmetric elasticity.

**MP4079 Final Year Project**

AUs: 10, Prerequisites: Promoted to Year 4, Semesters 1 and 2

Students are required to analyse and synthesise problems in any of the disciplines of mechanical and production engineering through a project requiring application of basic engineering principles. The project may take any one or a combination of the following forms: feasibility study, product development, computer modelling and analysis, design and construction, testing and experimental investigation.

**MP4A01 Aerodynamics**

AUs: 3, Prerequisites: MP2005 (Co-req: MP4005), Semester 1

Incompressible Airfoil Theory. Compressible Airfoil Theory. Wing Aerodynamics, Aircraft Aerodynamic Characteristics.

**MP4A02 Aircraft Structures**

AUs: 3, Prerequisites: MP2001, Semester 1

Structural components of an aircraft. Loads on aircraft. Mechanics of bars and thin plates. Aircraft structural components and structural idealisation. Open and closed thin-walled tubes. Multicell structures. Axial constraint. Practical aircraft structural analysis.

**MP4A03 Aircraft Propulsion**

AUs: 3, Prerequisites: MP2003 or MP2010, Semester 1

Fundamentals of aircraft propulsion. Analysis of propulsion cycles. Aerothermodynamics of intakes and nozzles. Gas turbine component characteristics. Gas turbine engine off-design performance. Solid-fueled propulsive devices.

**MP4A04 Flight Mechanics and Control**

AUs: 3, Prerequisites: MP4A01 and MP3001, Semester 2

Introduction to flight mechanics. Aircraft performance. Aircraft static stability and control. Linearisation of the aircraft equations of motion. Aircraft dynamic stability. Automatic control of flight vehicles.

**MP4A05 Mechanics of Aerospace Materials**

AUs: 3, Prerequisites: MP2001, Semester 1

Mechanics of composite materials. Plasticity and creep behaviour of materials. Fracture and fatigue. Non-destructive testing and NDT applications. Corrosion. Material failure analysis.

**MP4A06 Non-Destructive Testing**

AUs: 3, Prerequisites: MP2001, Semester 2

Review of NDT, NDT Methods.

**MP4A08 Computational Fluid Dynamics**

AUs: 3, Prerequisites: MP2005 and MP2006/AE2002 and MP2007/ AE2007, Corequisites: MP4005 or MP4A01 or AE3005

Governing Equations of Fluid Flow. Finite Difference and Finite Volume Schemes for Incompressible and Compressible Flow. Explicit, Implicit and Iterative Schemes. Notions of stability, convergence and accuracy of numerical approximations. Spatial and Temporal Discretisation schemes. Mesh generation. Initial and Boundary Conditions. Simulation of complex flows using user written as well as commercial flow codes.

**MP4C01 Biomechanics**

AUs: 3, Prerequisites: MP2001 and MP2005, Semester 1

Introduction. Musculo-skeletal system mechanics. Orthopaedic biomechanics. Cardiac functional mechanics. Cardiac valves, prostheses and assist. Hemodynamics. Lung mechanics.

**MP4C03 Biomaterials**

AUs: 3, Prerequisites: MP2004 or MP3104, Semester 1

History of biomaterials and case studies. Structure and property of biological materials. Processing, structure and property of biomaterials. Biocompatibility requirements. Interaction between human body environment and biomaterials. Analytical and testing techniques for biomaterials. Ethical issues and regulations.

**MP4C04 Surgical Assist Technology**

AUs: 3, Prerequisites: NIL, Semester 2

Introduction. Robotics for medical interventions. Surgical robots. Rapid prototyping in medicine and surgery. Rapid prototyping medical models. Computer visualisation. Augmented virtuality in medicine.

**MP4D01 Air Conditioning - An Energy Approach**

AUs: 3, Prerequisites: MP2003 and MP2005, Semester 1

Air-conditioning systems and applications. Psychrometrics, Comfort and Health. Heat transmission in building structures, Cooling Load, Cooling equipment. Chilled water distribution systems. Air distribution systems. Cooling system design sizing and energy calculations. Computer-aided load sizing of air-conditioning system.

**MP4D02 Building Services Engineering**

AUs: 3, Prerequisites: MP3003, Semester 2

Basics of fire sciences. Compartment fire and fundamentals of fire suppression. Fire fighting systems in buildings. Smoke control in buildings. Vertical transportation systems. Portable and waste water systems.

**MP4D04 Energy for a Sustainable Future**

AUs: 3, Prerequisites: MP2003 or MP2010, Semester 1

Energy resources. Energy and the environment. Efficient energy conversion technologies. Energy utilisation and management.

**MP4D05 Noise and Vibration Control**

AUs: 3, Prerequisites: NIL, Semester 1

Analysis of noise and vibration signals. Measurement of noise and vibration. Vibration testing for machines and structures. Vibration control techniques - isolation and damping. Noise control techniques - acoustical materials, enclosures, silencers and reverberation control.

**MP4D06 Clean Technology and the Environment**

AUs: 3, Prerequisites: NIL, Semester 2

Introduction to the concept of environment sustainable development. Industries and the environment. Clean technology and energy. Clean technology for electronic industry.

**MP4E01 Industrial Design**

AUs: 3, Prerequisites: NIL, Semester 1

Art and Industry. Basic Industrial Design. Design Elements and Principles. Colour. Industrial, Product and Packaging Graphics. Design Communications. Human Values in Design. Packaging Design.

**MP4E02 Human Factors in Design**

AUs: 3, Prerequisites: NIL, Semester 1

Introduction to human factors. Physical ergonomics. Cognitive ergonomics. Human-computer interaction. Human factors of product design. Socio-technical aspects of human factors in design.

**MP4E03 Strategic Management of Product Development**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

The course covers topics on critical product development considerations and competition strategies, the role of prototyping in product design and manufacturing, the organisation and management of cross functional product development teams, the capture and modelling of customer needs, risk assessment and management, the role of R & D, and the strategies for achieving fast cycle competition and time to market. The teaching approach of a graduate management course will be used, with equal emphasis on lectures and case analysis and presentation by students.

**MP4E04 Mechanisms Design**

AUs: 3, Prerequisites: MP2002, Semester 2

Introduction to mechanism synthesis. graphical and analytical methods. Advanced planar mechanism synthesis. Spatial mechanism fundamentals. Screw theory. Kinematic analysis of spatial mechanisms.

**MP4E05 Materials Selection and Design**

AUs: 3, Prerequisites: NIL, Semester 2

Review of basic engineering materials properties. Materials selection in design. Process selection in design.

**MP4E06 Visualisation and Virtual Reality in Product Design**

AUs: 3, Prerequisites: NIL, Semester 2

Introduction. Computer Graphics. Visualisation. Volume Visualisation. VR Fundamentals. VR Interaction. VR Modelling, Algorithm and Software. VR Hardware Devices.

**MP4F01 Materials Engineering**

AUs: 3, Prerequisites: MP2004 or MP3104, Semester 1

Engineering Ceramics. Electronics Materials. Speciality Steels and Metallic Alloys. Non-destructive Testing. Plastic Materials. Plastic Processing. Composite Materials.

**MP4F02 Manufacturing Systems and Automation**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Manufacturing systems. Rapid prototyping and applications. Computer-aided manufacturing. Industrial robots. Automatic assembly.

**MP4F03 Quality Assurance and Management**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Fundamental concepts. Acceptance sampling and control charts. Design of experiments. Reliability engineering. Total quality management. ISO 9000 series quality management systems. Environmental management systems.

**MP4F04 Integrated Supply Chains**

AUs: 3, Prerequisites: NIL, Semester 2

Concepts of Supply Chain Integration. Role of supply chains in manufacturing and services. Materials, information and payment flows systems. Customer relations and supplier development, Advanced Inventory systems. SCM. E-logistics, Technologies of communication and information for supply chains. Warehousing, distribution, freight and transportation engineering and management systems. Business models. Performance Measurements. Software applications.

**MP4F05 Operations Research**

AUs: 3, Prerequisites: NIL, Semester 1

The engineering and management dimensions of operations analysis and modelling. Optimisation. Mathematical and linear programming; extension, transportation and assignment problems, integer programming. Probabilistic models. Decision-making under uncertainty. Utility and risks analysis. Bayesian decision models. Replacement policies. Queuing models. Inventory models, planning and control. Simulation. Functional applications to manufacturing, new product development, R and D, logistics and marketing.

**MP4F06 Engineering Logistics**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Introduction to logistics engineering. Strategic supply chain management. Logistics information management. Demand forecasting and analytic models in logistics. Logistics systems simulation. Material management in logistics.

**MP4F07 Net Shape Manufacturing**

AUs: 3, Prerequisites: MP2004 or MP3104, Semester 2

Advanced metal casting. Powder metallurgy and powder forming processes. Sheet metal forming processes. Forging and extrusion. Plastics forming processes.

**MP4F09 High Vacuum Technology**

AUs: 3, Prerequisites: NIL, Semester 2

Introduction. Physical Concepts. Vacuum Measurement. Mechanical Pumps. Diffusion Pumps. Turbomolecular Pumps. Cryopumps. Sorption and Getter Pumps. Vacuum Accessories and Design. Vacuum Materials. Vacuum System Design. Vacuum Leak Detection. Cleaning Techniques. Sealing Techniques and Vacuum Applications.

**MP4F10 Electronics Manufacturing and Packaging**

AUs: 3, Prerequisites: M286/M286M or MP2004/MP3104, Semester 1

Overview to electronics manufacturing packaging. Interconnection technology, wire-bonding and flip-chip bonding technologies. Plastic package assembly technology and Surface mount assembly technology. Wafer-level fabrication techniques, wafer-level and MEMS packaging applications, Hermetic packaging and assembly. Packaging technology and trends, Package design types and characteristics, Package design considerations for materials, thermal and reliability performance.

**MP4G02 Robotics**

AUs: 3, Prerequisites: NIL, Semester 1

Introduction to robotics. Robot actuators and sensing systems. Fundamentals of rigid body motion. Kinematics of robot manipulators. Motion planning and programming. Dynamics and control of robot manipulators. Robotics design and applications.

**MP4G03 Motion Control Systems**

AUs: 3, Prerequisites: MP3001, Semester 1

Elements of motion control system covering permanent magnet servo motors, positional and velocity transducers, servo amplifiers, and micro-processor interfacing. Modelling, analysis and design of digital control systems. Optimal design of motion control system.

**MP4G05 Microprocessor Systems**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Fundamental of microprocessor architecture. Concepts and techniques of memory organisation, stacks and the use of interrupts. Data representation and operation. Programming. Timers and I/O operations. Basic and display electronics. Interfacing to digital devices.

**MP4G08 Biomechatronics**

AUs: 3, Prerequisites: NIL, Semester 2

Introduction. Modelling and pre-operative planning and principles of computer based imaging techniques. On-line measurement involving parametric modelling, sensors and feedback systems. Therapeutic and surgical devices and safety aspects.

**MP4J01 Naval Architecture and Marine Engineering**

AUs: 3, Prerequisites: MP2003 and MP2001 or MP2010 and MP2001 <ambiguous, need to add a comma where appropriate>, Semester 1

Ship Layout and Stability. Ship Structural Strength. Ship Resistance. Ship Propulsion. Marine Power Plants. Advanced Power Plant Technologies. Ship Service Systems.

**MP4J02 Marine and Offshore Structural Integrity**

AUs: 3, Prerequisites: MP2001, Semester 2

Loads and its effect on Marine structures. Analysis of Marine structures. Fatigue and fracture analysis in Marine engineering systems component. Failure analysis in Marine engineering systems component. Structural integrity design of welded structures. Structural integrity design of Offshore structures.

**MP4J03 Marine Engineering Systems and Control**

AUs: 3, Prerequisites: MP2008, Semester 2

Electrical machines and Electrical power systems, Fluid power control, Pumps and Piping systems, Automation and Control.

**General Education Requirement – Unrestricted Electives (GER-UE)**

**MP0103 Creative Problem Solving**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

This is a project-based learning course. Students will undertake a series of individual and group projects to enhance their creativity skills. Lectures will be given on the following topics to guide students: introduction to creativity, individual creativity techniques, group creativity techniques, leading creative teams.

**MP0104 Undergraduate Research Opportunity Programme**

AUs: 3, Prerequisites: Year 3 students only, Offered during May/June and December/January

The course involves individual undergraduate students to pursue, over six weeks, appropriate levels of independent research work. The work may take the form of one or more of the followings: Search and review of literatures; collection, classification and analysis of data; experimental set-up, measurements and analysis; theoretical and/or computational analysis; technical and/or other feasibility investigations; development of techniques, processes, materials, software, hardware and/or other products.

**MP0107 Mind of Sun Tzu**

AUs: 3, Prerequisites: NIL, Semester 2

Mind of the Strategist. Quantification in Strategic Thinking. Configuration of Forces. Changes. Taxonomy of Grounds. Attack by Fire (Technology). Project on Art of War and Strategic Thinking.



**MP0110 Dynamics of Teamwork and Cooperation**

AUs: 2, Prerequisites: NIL, Semester 2

Introductory lecture. What is a team? Advantages of teamwork and cooperation. Disadvantages of teamwork and cooperation. Underlying processes of teamwork. Anthropological and cross cultural perspectives. Sociobiological perspectives. Measurement of team performance. Technology support for team and group work.

**General Education Requirement – Prescribed Electives (GER-PE)**

**MP8082 Systems for Everyone**

AUs: 3, Prerequisites: NIL, Semesters 1 and 2

Systems principles, Visualising techniques for modelling systems. System problem solving. System failures. Assignment.

**MP8083 Frontiers in Mechanical Engineering**

AUs: 3, Prerequisites: NIL, Semester 2

Introduction. Micro Electro-Mechanical Systems. Nanotechnology. Robotics. Human Centric Engineering And Design

**MP8084 Infrared Technology in Engineering, Medicine and Biology**

AUs: 3, Prerequisites: NIL, Semester 1

Principles of Thermal Imaging; Industrial and Civil Applications of Infrared Thermography; Practical Session on Thermal Imaging; Medical Diagnostic Thermography; Thermal Physiology; Veterinary and Vascular Thermography; Clinical Case Studies; Recent Advances of Telethermometry in Medical Diagnosis and Management.

**MP8085 History of Great Inventions**

AUs: 3, Prerequisites: NIL, Semester 2 and Special Term 1

Module one: The first sparks of genius: how technology made civilisation possible (2.6 million BC to AD1).

Module two: Looking at new horizons: spreading knowledge and shrinking the globe (AD1 to 1649).

Module three: The age of industrial power: harnessing steam brings a new way of life (1650 to 1829).

Module four: Electricity on the move: the story of light, sound and motion (1830 to 1899).

Module five: Journey into the atomic age: two world wars force the pace of change (1900 to 1944).

Module six: Reinventing the world: living with the chip and the gene (1945 to 2000 and beyond).

**MP2014 Engineering Management Analysis**

AUs: 3, Prerequisites: NIL, Semester 1

Principles of engineering economy as a basis for engineering management. Rates of return, cost of capital, economic value added. Production decisions, capital investment, replacement analysis. Risks analysis. Innovations and R & D. International manufacturing and operations. Competitive analysis of industry.

**Bachelor of Engineering (Aerospace Engineering)**

**YEAR 1**

**AE1001 Discovery Course I**

AUs: 2, Prerequisites: NIL, Semester 1

Historical Perspective of Aerospace Engineering. Overview of Aerospace Clusters. Introduction to Aerodynamics. Introduction to Propulsion and Gte. Overview of Aircraft Support Systems. Introduction to Aerospace Materials. Introduction to Maintenance, Reliability and Overhaul (Mro).

**AE1002 Discovery Course II**

AUs: 1, Prerequisites: AE1001, Semester 2

Visit to Science Centre and RSAF Museum. Flight Appreciation Exercise (Youth Flying) Club). Aerodynamics - National Wind Tunnel (swift). Discovery Lab.

**YEAR 2**

**AE2001 Fluid Mechanics**

AUs: 4, Prerequisites: NIL, Semester 1

Submerged surfaces and bodies. Elementary fluid dynamics. Momentum equation and its application. Dimensional analysis and similtude. Internal flows and piping systems. Principles and applications of fluid machines.

**AE2002 Mathematics 3**

AUs: 3, Prerequisites: NIL, Semester 1  
Probability and Statistics. Matrix Analysis/Linear Algebra. Vector Differential Calculus. Vector Integral Calculus.

**AE2003 Aerodynamics I**

AUs: 3, Prerequisites: AE2001, Semester 2  
Introduction. Governing Equations, Fundamentals of Inviscid Incompressible Flow Viscous Boundary Layers. Parameters for Airfoil and Wing Characteristics Incompressible Flows Around Airfoils. Incompressible Flows About Wings of Finite Span. Experimental Aerodynamics. Computational Fluid Dynamics.

**AE2004 Circuits and Electronics**

AUs: 3, Prerequisites: NIL, Semester 1  
DC Circuit Analysis. AC Circuit Analysis. Introduction to Electronics. Digital Electronics. Operational Amplifier Circuits.

**AE2005 Aerospace Dynamics**

AUs: 3, Prerequisites: NIL, Semester 1  
Basic Vector Kinematics - Basic Dynamics Principles Dynamics of Rigid Bodies Basic Concept of Stability.

**AE2006 Thermodynamics**

AUs: 4, Prerequisites: NIL, Semester 2  
Properties of pure substances. Work and heat. Energy and the first law. Energy balance for closed systems and steady state control volumes. Second law and entropy. Entropy balance for closed systems and steady state control volumes. Thermodynamic cycles for power plants and refrigeration systems. Ideal gas mixtures and psychrometrics. Reacting mixtures and combustion.

**AE2007 Mathematics 4**

AUs: 3, Prerequisites: NIL, Semester 2  
Complex Variables. Fourier Analysis. Laplace Transform. Partial Differential Equations.

**AE2008 Mechanics of Materials**

AUs: 3, Prerequisites: FE1001 or G162, Semester 1  
Review of concepts of equilibrium and free body diagram. Stress and strain. Torsion. Bending stresses in beams. Shearing stresses in beams. Transformation of stress and strain. Yield and fracture criteria. Deflection of beams. Columns.

**AE2009 Aerospace Materials**

AUs: 3, Prerequisites: FE1005, Semester 2  
Material's deformation and strength. Strengthening principles. Key materials properties for aerospace materials. Lightweight materials. High temperature materials. Material's selection.

**AE2011 Introduction to Aircraft Design and Manufacturing**

AUs: 3, Prerequisites: NIL, Semester 2  
Graphics. Computer-Aided Design. Fundamentals of Aircraft Design. Introduction to Manufacturing. Manufacturing Processes. Machining, Joining and Finishing Processes. Production and Quality Control.

**AE2071 Laboratory 2A**

AUs: 1, Prerequisites: NIL, Semester 1  
Laboratory experiments and projects to provide practical application and understanding of theories relating to second year aerospace engineering.

**AE2072 Laboratory 2B**

AUs: 1, Prerequisites: NIL, Semester 2  
Laboratory experiments and projects to provide practical application and understanding of theories relating to second year aerospace engineering.

**HW210 Technical Communication**

AUs: 2, Prerequisites: NIL, Semesters 1 and 2  
The content of the syllabus is taught through project work. The project-based learning approach is used throughout to ensure active participation in the process of learning technical communication.

**MP2079 Engineering Innovation and Design**

AUs: 2, Prerequisites: NIL, Special Term 1

Computer Aided Design and Engineering. Design for assembly. Innovation product design. Design modelling. Engineering analysis. Appreciation of manufacturing processes. Pneumatic control. Mechatronics design and assembly. Material selection. Introduction to Business Planning, and Project Management. Practice in generating creative products, technology and innovative engineering solutions through T21 project.

**YEAR 3**

**AE3001 Aircraft Structures I**

AUs: 3, Prerequisites: AE2005 and AE2008, Semester 1

Structural Components of An Aircraft, Loads on Aircraft, Fundamentals of Vibration, Vibration of Single Degree of Freedom Systems, Vibration of Multiply Degrees of Freedom Systems, Vibration of Continuous Systems, Vibration Measurement and Control.

**AE3002 Flight Mechanics**

AUs: 3, Prerequisites: AE2003 and AE2005, Semester 1

Review of Flight Environment and Flight Forces, Steady Flight Performance, Aircraft Manoeuvre Performance, Aircraft Static Stability and Control, Linearisation of the Aircraft Equations of Motion, Aircraft Dynamic Stability.

**AE3003 Heat Transfer**

AUs: 3, Prerequisites: AE2006, Semester 1

Conduction: formulation of heat conduction problems, one dimensional problems, conduction with heat generation, fin and general lumped capacitance analysis. Convection: conservation transfer equations, dimensional analysis, flow over flat plate, forced convection in pipes, forced convection correlations, free convection correlations. Heat exchanges analysis. Radiation: black body radiation exchange, radiation exchange between multi-gray surfaces.

**AE3004 Aircraft Electrical Devices and Systems**

AUs: 3, Prerequisites: NIL, Semester 1

Electrical Components, Motors and Generators, Aircraft Power Electronics, AC and DC Power Systems.

**AE3005 Aerodynamics II**

AUs: 3, Prerequisites: AE2003, Semester 1

Introduction, Dynamics of Compression Flow Fluid Field, Compressible Subsonic Flows and Transonic Flows, Supersonic Flows, Hypersonic Flows, Computational Fluid Dynamics, Biological Inspired Aerodynamics, Rotorcraft Aerodynamics, Aerodynamic Design Considerations.

**AE3006 Aircraft Propulsion**

AUs: 3, Prerequisites: AE2006, Semester 1

Essentials of Thermodynamics, Fundamentals of Aircraft Propulsion, Propulsion Engines and Performance Analysis, Performance Improvement of Gas Turbine Engine, Engine and Airframe Integration, New Developments and Related Issues.

**AE3071 Aerospace Laboratory**

AUs: 1, Prerequisites: AE1001, AE1002 AND AE2009 Co-Requisite: AE3002, Semester 1

This course comprises five experiments and three laboratory projects which builds on the several courses offered in the first second and third year of the Aerospace Engineering programme.

**AE3079 Industrial Attachment**

AUs: 10, Prerequisites: Promoted to Year 3, Semester 2

Through a 22-week industrial attachment, students can expect to gain first-hand knowledge of day-to-day operations in the Mechanical Engineering profession; apply the acquired knowledge and skills in actual planning, design, production, construction and/or operation/maintenance practices; and become knowledgeable in field problems and requirements of the industry.

**YEAR 4**

**AE4001 Aircraft Structures II**

AUs: 3, Prerequisites: AE2008, Semester 1

Mechanics of Bars, Beams and Plates. Structural Instability, Deformations and Stresses in Thin-Walled Structures. Open and Closed Tubes. Introduction to the Basics of the Finite Element Method (FEM). 1-D and 2-D Elements.

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Practical Application of FEM in the Analysis of Aerospace Components, Plasticity, Creep and Corrosion in Aerospace Materials. Fracture Mechanics and Fatigue Analysis in Aircraft Design. Advanced Non-Destructive Testing Techniques.

**AE4002 Aerospace Control Theory**

AUs: 3, Prerequisites: AE3002, Semester 1

Introduction to state space formulation. Analysis and synthesis of automatic flight control systems. Transfer functions. Stability, root locus, Nyquist and Bode techniques. Lead-lag, PID compensators. Applications.

**AE4003 Aircraft Navigation and Flight Computers**

AUs: 3, Prerequisites: NIL, Semester 1

Introduction to Signal and Processes. Inertial Navigation. Basics of Navigation Data Processing. Fundamental of Trend of Flight Computer.

**AE4007 Engineers and Society**

AUs: 3, Prerequisites: NIL, Semester 1

Our country. Engineers in society. Our world in the new Millennium.

**AE4008 Human Resource Management**

AUs: 3, Prerequisites: NIL, Semester 2

The Nature of Human Relations. The study of individual behavior. Behavior of Groups and Productivity Practices. Managing Technological Change. Managing in Knowledge-based Futures. Fundamentals of Leadership. HRM Skills of a Leader: Developing, Appraising and Rewarding Staff. Managing Performance: Corporate, Group and Individual. Productivity Innovation, Creativity and Incentive Culture. Internationalisation and HRM. Managing Industrial Relations, Personal Career Development, Topical HRM Issues.

**AE4011 Aircraft Design**

AUs: 3, Prerequisites: AE3002, AE3005 and AE3006, Semester 1

Introduction and Overview of the Aircraft Design Process. Initial Design Estimates and Configuration Layout. Review (Aerodynamics, Aerostructures, Aircraft Performance and Flight Mechanics). Propulsion and Fuel System Integration. Aircraft Systems Integration. Airworthiness, Certification and Environmental Considerations. Cost Analysis. Case Studies. Invited Lectures.

**AE4079 Final Year Project**

AUs: 10, Prerequisites: Promoted to Year 4, Semesters 1 and 2

Students are required to analyse and synthesis problems in any of the disciplines of aerospace engineering through a project requiring application of basic engineering principles. The project may take any one or a combination of the following forms: feasibility study, product development. Computer modelling and analysis, design and construction, testing and experimental investigation.

**AEROSPACE ENGINEERING Major Prescribed Electives**

**AE4101 Space flight Dynamics** (not offered in AY2008/09)

AUs: 3, Prerequisites: AE2005, Semester 2

Introduction of the basic principles of astronautics, covering orbital mechanics including space environmental effects, launch-vehicle performance, and spacecraft attitude dynamics and control.

**AE4102 Satellite Engineering** (not offered in AY2008/09)

AUs: 3, Prerequisites: Promoted to 4<sup>th</sup> Year, Semester 2

Introduction to Satellite Engineering. Space Environment. Functional Requirements for the Satellite Sub-systems. Satellite System Design and Operational Issues.

**AE4103 Aviation Management and Operation**

AUs: 3, Prerequisites: MP2014 (For non-AERO students and exchange students only), Semester 2

Introduction and Overview of Aviation Management and Operations. Airport Planning. Aviation Management and Operation. Ground and Baggage Handling Systems, Terminal and Cargo Operations, and Aviation Information Management. Aviation Security, Emergencies, Regulations and Forensic. Case Study and Invited Lectures.

**AE4104 Computational Fluid Dynamics**

AUs: 3, Prerequisites: AE2001/MP2005 and AE2002/MP2006 and AE2007/MP2007 Mathematics 4, Co-requisites: MP4005 or MP4A01 or AE3005, Semester 2

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Introduction to Computational Fluid Dynamics. Basic Concepts of Discretisation. Numerical Solution of Model Flow Equations. Complex Geometries and Mesh Generation. Turbulence Models. Invited Industrial Application Seminar. Computational Fluid Dynamics Laboratory Experiments.

**AE4105 Rotary Wing Aircraft**

AUs: 3, Prerequisites: AE3005 (for AERO students); MP4A01 (For Non-AE Students only), Semester 2  
Introduction. Basic Rotor Aerodynamics: Classical Momentum Theory and Blade Element Theory. Vortex Theory. Rotor Wake. Axial Flight Regimes. Forward Flight: Rotor Blade Dynamics and Aerodynamics. Rotocraft Performance. Introduction to Trim, Stability and Control. Special Topics: Conceptual Design for Rotocraft. Introduction to Rotor Aeroacoustics.

**AE4106 Unmanned Aerial Vehicles**

AUs: 3, Prerequisites: AE3002, AE3005 Semester 2  
Introduction. Overview of UAF systems. Aerodynamics. Performance. Stability and Control. Propulsion. Rotary Craft of UAV. Mission Planning and Payloads. Launch and Recovery. Micro Air Vehicles.