PART B SYLLABUSES

SUBJECT DESCRIPTION FORM

Subject Title: Mathematics II

Subject Code: AMA294

Credit Value: 3

Pre-requisite: Nil

Learning Activities:

Lecture	28 hours
Tutorial and Student Presentation	14 hours
Total	42 hours

The lectures aim to provide the students with an integrated knowledge required for the understanding and application of mathematical concepts and techniques. To develop students' ability for logical thinking and effective communication, tutorial and presentation sessions will be held.

Assessment:

Continuous Assessment	40%
Examination	60%
Total	100%

To pass this subject, students are required to obtain Grade D or above in **both** the Continuous Assessment and the Examination components.

Learning Outcomes:

The subject aims to introduce students to some fundamental knowledge of engineering mathematics. The emphasis will be on application of mathematical methods to solving practical engineering problems.

Upon satisfactory completion of the subject, students are expected to be able to:

(i) apply mathematical reasoning to analyse essential features of different engineering problems such as partial differential equations;

(ii) extend their knowledge of mathematical techniques, such as expansion in terms of Fourier Series, and adapt known solutions to different situations of engineering context;

(iii) develop and extrapolate mathematical concepts in synthesizing and solving engineering problems;

(iv) search for useful information and use statistical tables in solving statistical problems in the context of engineering.

Syllabus:

Linear Algebra
Eigenvalues and eigenvectors; Normalisation and orthogonality.

Complex variables:
Revision of complex numbers; Functions of a complex variable; Continuity; Derivatives and Cauchy-Riemann relations.

Partial differential equations:
Formulation pf partial differential equations; Method of separation of variables; Initial and boundary value problems.

Statistics:
Probability and random variables; Probability distributions; Sampling distributions of the mean; Estimation and hypothesis testing; Linear regression.

Textbooks and Reference Books:

G.B. Thomas, R.L. Finney, J.R. Hass & F.R. Giordano	Thomas' Calculus 11th edition	Addison Wesley 2004
G. James	Modern Engineering Mathematics 4th edition	Pearson Eduction 2007
H. Anton	Elementary Linear Algebra 9th edition	John Wiley & Sons 2004
R.E. Walpole R.H. Myers S.L. Myers K. Ye	Probability and Statistics for Engineers and Scientists, 8th edition	Prentice Hall 2006

SUBJECT DESCRIPTION FORM

Subject Title: Professional English for Engineering Students

Subject Code: ELC3502

Number of Credits: 2

Hours Assigned: 28 hours

Pre-requisite: Nil
Co-requisite: Nil
Exclusion: Nil

Objectives:

This subject aims to develop the English language skills required by students to communicate effectively in their professional careers.

Student Learning Outcomes:

By the end of the subject, students should be able to communicate effectively in workplace contexts through

1. participating in, and contributing to, workplace meetings,
2. writing job-related correspondence,
3. writing documents to introduce and promote an organisation as well as a product or a service, and
4. writing summaries for job-related documents.

Content:

This content is indicative. The balance of the components, and the corresponding weighting, will be based on the specific needs of the students.

1. **Workplace meetings**
   Practising the specific verbal skills required when communicating with co-workers at meetings.

2. **Workplace correspondence**
   Selecting and using relevant content; organising ideas and information; maintaining appropriate tone, distance and level of formality; achieving coherence and cohesion; adopting an appropriate style, format, structure and layout.

3. **Workplace reports**
   Selecting and using relevant content; organising ideas and information; writing executive summaries for long reports, describing tables and graphs; discussing and analysing data; adopting an appropriate style, format, structure and layout.

4. **Language appropriacy**
   Using context-sensitive language in spoken and written English.

5. **Language development**
   Improving and extending relevant features of grammar, vocabulary and pronunciation.

Teaching and Learning Approach and Teaching Schedule:

The subject is designed to introduce students to the communication skills, both oral and written, that they may need to function effectively in their future professions.

The study method is primarily seminar-project-based. Activities include teacher input as well as individual and group work involving drafting and evaluating texts, mini-presentations, discussions and simulations. Students will be referred to information on the Internet and the ELC's Centre for Independent Language Learning.

Learning materials developed by the English Language Centre are used throughout this course. Additional reference materials will be recommended as required.

Method of Assessment:

Continuous assessment: 100%

Students' oral and writing skills are evaluated through assessment tasks related to the learning outcomes. Students are assessed on the accuracy and the appropriacy of the language used in fulfilling the assessment tasks, as well as the selection and organisation of ideas.

Reference Books:

1. Ashley, A. (1992). *A handbook of commercial correspondence* (2nd ed.). Oxford: Oxford University Press.
2. Aspinall, T. & Bethell, G. (2003). *Test your business vocabulary in use* (1st ed.). Cambridge: Cambridge University Press.
3. Bilbow, G. T. (2004). *Business writing for Hong Kong* (3rd ed.). Hong Kong: Longman.
4. Conradi, M. & Hall, R. (2001). *That presentation sensation*. London: Pearson Education Ltd.
5. Guffey, M. E. (2004). *Essentials of business communication* (6th ed.). Mason, OH: South-Western College Publication.
6. Houp, K. W., Pearsall, T. E., Tebeaux, E. & Dragga, S. (2006). *Reporting technical information* (11th ed.). New York: Oxford University Press.
7. Sampson, E. (2003). *Creative business presentation: Inventive ideas for making an instant impact.* London: Kogan Page.
   Walther, G. R. (1996). *Power talking skills: How to say what you mean and get what you want.* A video seminar. Newcastle, WA: Speaking From Experience, Inc.
8. White, F. D. (1996). *Communicating technology: Dynamic processes and models for writers*. New York: Harper Collins College Publishers.

SUBJECT DESCRIPTION FORM

Subject Title: Engineering Management **Subject Code:** ENG306

Number of Credits: 3 **Hours Assigned:** Lecture/Tutorial 42 hours

Pre-requisite: Nil
Co-requisite: Nil
Exclusion: Nil

Objectives:

This subject will provide students with:
1. The skills and techniques involved in management of people and engineering activities in the production of goods and services.
2. The skills in the use and understanding of different quality management tools and techniques in an organisation, hence enable students to interpret the quality work content of typical jobs.
3. The background to understand ethical and business behaviours in engineering organizations, and the change management techniques.

Student Subject Learning Outcomes:
Category A: Professional/ academic knowledge and skills
Category B: Attributes for all-roundedness

1. The ability to analyse the organisation structure, and identify the importance of planning and strategic management on the success of organizations in both manufacturing, and service sectors. *(Objective 1 and Syllabus Item 1). Category A*
2. The ability to apply appropriate management techniques to improve organization structure and procedures, and quality management. *(Objective 2 and Syllabus Item 2). Category A*
3. The ability to apply appropriate project management techniques to analyze project activities. *(Objective 1 and Syllabus Item 3). Category A*
4. The ability to analyse factors affecting the changes in the work environment; and to control and manage the change activities. *(Objective 3 and Syllabus Item 4). Categories A & B*
5. The ability to recognise the environmental factors that affect on operations of engineering organizations in Hong Kong, and the ethical issues in business environment. *(Objective 3 and Syllabus Item 5). Categories A & B*

Syllabus:

Introduction - General management concepts in organizations; functions & types of industrial organizations, structure, corporate objectives, strategy and policy

Industrial Management - Roles of managers. Process of management, planning, organising, motivating, leading and controlling of social and engineering activities. Quality management and tools.

Project Management - Project scope and objectives, network analysis. Tools that support engineering operations and scheduling.

Management of Change - Strategic leadership and innovation, organizational change, leading planned change, organisation development, stress and stress management. Factors that affect the execution of changes.

Effects of Environmental Factors - The effects of environmental factors on the operations of engineering organizations in Hong Kong, e.g. corporate social responsibilities.

Teaching and Learning Approach:

A mixture of lectures, tutorial exercises, and case studies will be used to deliver the various topics in this subject. Some of which will be covered in a problem-based format where this enhances the learning objectives. Others will be covered through directed study in order to enhance the students' ability of "learning to learn". Some case studies, largely based on real experience will be used to integrate these topics and thus demonstrate to students how the various techniques are inter-related and how they apply in real life situations.

Method of Assessment:

Overall Assessment: 0.60 × End of Subject Examination + 0.40 × Continuous Assessment

Coursework comprises assignments with individual and group components; and team work is an essential element in the coursework assessment. All assessment components will require students to apply what they have learnt to realistic work applications.

Reference books:

1. Babcock, D. L. and Morse, L.C., Managing engineering and technology: an introduction to management for engineers, 3rd Ed., Prentice Hall, 2002.
2. Kerzner, H., Project Management: a systems approach to planning, scheduling, and controlling, 9th Ed., Wiley, 2005.
3. Mazda, F.F., Engineering management, Addison-Wesley, 1998.
4. Robbins, S.P. and Coulter, M., Management, 8th Ed., Prentice-Hall, 2005.
5. Schermerhorn, J.R. Jr., Management, 8th Ed., Wiley, 2005.

SUBJECT DESCRIPTION FORM

Subject Title: Society and the Engineer **Subject Code:** ENG307

Number of Credits: 3 **Hours Assigned:** Lecture/Case Study/Seminar
Total 42 hours

Pre-requisite: Nil
Co-requisite: Nil
Exclusion: Nil

Objectives:

This subject is designed for engineering students as a complementary subject about the role of the professional engineer in practice and their responsibilities towards the profession, colleagues, employers, clients and the public. The objectives of the subject are to enable students to:

1. appreciate the historical context of modern technology and the nature of the process whereby technology develops.
2. understand the social, political, economic responsibility and accountability of a profession in engineering and the organizational activities of professional engineering institutions.
3. appreciate the relationship between technology and environment and the implied social costs and benefits.
4. be aware of the short-term and long-term effects on the use of technology relating to safety, health and welfare aspects.
5. observe the professional conduct, the legal and more constraints relating to various engineering aspects.

In class, there will be short lectures to provide essential knowledge and information on the relationship between society and the engineer under a range of dimensions. There will be discussions, case studies, seminars to engage student's in-dept analysis of the relationship.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Attributes for all-roundedness

1. Describe different types of intellectual protection and evaluate impacts of modern technology on education, business and societal development. *Category A*
2. Explain the importance of professional conduct and responsibilities in various engineering activities. *Category A*
3. Identify the effects on the use of technology relating to health and safety, environment and welfare of the public in real life cases. *Category A*
4. Interpret the academic, training and professional experience requirement of local and overseas of professional engineering institutions. *Category A*
5. Discuss, in a team setting, the social problems related to engineers and present the findings. *Category B*

Syllabus:

Trend and transfer of technology. Impact of technology on society. Innovation and creativity. Quality assurance and product life-cycle.

Environmental protection and related issues. Role of the engineer in energy conservation, ecological balance and sustainable development.

The outlook of Hong Kong's industry, its supporting organizations and impact on development from the China Markets.

Industrial health and safety including the work of the Labour Department and the Occupational Health and Safety Council. Industrial legislation.

The Professional Institutions: both local and overseas. Training of engineers.

Professional ethics, bribery and corruption including the work of the ICAC. Social responsibilities of engineers.

Intellectual property right such as patents and copyright protection. Contract law for engineers.

Method of Assessment:

Overall Assessment: 0.40 × End of Subject Examination + 0.60 × Continuous Assessment

Students will form into groups and throughout the course, students will work on engineering cases by completing the following learning activities:
1. Case analysis;
2. Presentation;
3. Case portfolio; and
4. Final presentation.

Reference book:
1. Johnston, F. Stephen, Gostelow, J.P. and King, W. Joseph (2000) Engineering and society challenges of professional practice. Upper Saddle River, N.J.: Prentice Hall
2. Hjorth, Linda; Eichler, Barbara; Khan, Ahmed (2003) Technology and Society Abridge to the 21st Century. Upper Saddle River, N.J.: Prentice Hall

Reading material:
Engineering journals:
- Engineers by The Hong Kong Institution of Engineers
- Engineering and Technology by The Institution of Engineers and Technology

Magazines:
- Times
- Far East Economics

Current newspaper:
- South China Morning Post
- China Daily
- Ming Pao Daily

April 2007

SUBJECT DESCRIPTION FORM

Subject Title: Engineering and the Environment

Subject Code: ME2902

Number of Credits: 3

Hours Assigned: Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: Nil
Co-requisite: Nil
Exclusion: Nil

Objectives:

To teach the students:
1. fundamental concepts of the global environmental problems.
2. fundamental concepts of air, noise, water and solid waste pollutions, and their impacts to the environment.
3. fundamental engineering knowledge to tackle the environmental problems.
4. fundamental concepts of the importance of environmental management.

Student Subject Learning Outcomes:
Category A: Professional/ academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to appreciate and understand the concept of flow of energy, nutrients and pollutants in an ecosystem. *Category A*
2. Able to understand and identify the global environmental problems. *Category B*
3. Able to understand and identify the sources of pollutants in our community and their relationship with environmental problems. *Categories A and B*
4. Able to understand the basic concepts of air, noise, water and solid waste pollutions, and evaluate their impacts to the environment. *Categories A and B*
5. Able to apply the fundamental engineering knowledge to tackle the environmental problems caused by the air, noise, water and solid waste pollutions. *Categories A and B*
6. Able to appreciate and understand the roles of different sectors of our community including government, industry and engineers in the development and implementation of environmental management policies and strategies. *Categories A and B*

Syllabus:

Global Environmental Problems - Ecosystem, energy flow and nutrient cycles. Basic definition of environmental pollutions. Factors enhancing environmental problems. Environmental Impact Matrices.

Air Pollution - The atmosphere. Principal air pollutants. Sources and effects of air pollution. Outdoor and indoor air pollution. Air Pollution Index. Control of air pollution. Indoor Air Quality (IAQ). Control of IAQ.

Noise Pollution - Basic concepts of sound and noise. Basic concepts of hearing: hearing loss, weighting noise level, Noise Criteria (NC) curves and Speech Interference Level (SIL). Control of noise pollution.

Water Pollution - Water quality. Sources of water pollution. Municipal and industrial waste water. Qualities of polluted water. Water treatment processes. Residuals management.

Solid Waste Pollution - Solid waste disposal hierarchy. Solid waste sources: municipal and industrial sources. Concept of "Reduce-Reuse-Recycling". Composting. Landfill. Incineration.

Environmental Management - Sustainable development. Environmental Impact Assessment (EIA). Environmental Impact Statement (EIS). Government strategies in pollution control. Subsides and Polluter Pays Principle. Sources of environmental information and regulations.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is a student's full responsibility to complete the assigned problems individually except the group projects/cases and to ask any question on those assigned problems if he/she has encountered any difficulty. Any student who is found to plagiarize the work of others will be given "zero" mark for that particular assignment. Students are advised to obtain help from the subject lecturer whenever necessary.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the subject lecturer and programme leader concerned ahead of time. In the event of absence, it is the student's full responsibility to catch up on any missed assignment.

Reference books:

1. M.L. Davis, and S.J. Masten, Principles of Environmental Engineering and Science, McGraw-Hill, 2004.
2. J. Glynn Henry, and Gary W. Heinke, Environmental Science and Engineering, 2nd edition, Prentice-Hall, 1996.
3. D.D. Reible, Fundamentals of Environmental Engineering, Lewis Publishers, 1999.
4. W.W. Nazaroff and L. Alvarez-Cohen, Environmental Engineering Science, John Wiley and Sons, Inc., 2001.
5. NSI/ASHRAE Standard 62-1989: Ventilation for Acceptable Indoor Air Quality, ASHRAE, 1989.
6. I. Sharland, Woods Practical Guide to Noise Control, Woods Acoustics, 1979.
7. EPD of HKSAR: Homepage – http://www.epd.gov.hk
8. US EPA: Homepage – http://www.epa.gov

August 2008

SUBJECT DESCRIPTION FORM

Subject Title: Dynamics and Vibrations **Subject Code:** ME3106

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3301 Applied Mechanics
Co-requisite: Nil
Exclusion: ME3101 Dynamics and Control I
ME3102 Dynamics and Control II
ME3104 Dynamics and Control I

Objectives:

1. To enable students to master the methods of problem formulation and solution for planar motion of particles and rigid bodies.
2. To introduce the concepts and usages of work and energy.
3. To introduce the elementary tools of modelling physical components and systems.
4. To provide fundamental concepts and solution strategies for mechanical vibration problems.
5. To introduce knowledge and techniques for theoretical, numerical and experimental determination of vibration parameters for single-degree-of-freedom systems.
6. To provide methods of calculating safe rotating speed range to avoid whirling of shaft.
7. To show how to solve vibration and dynamics problems occurring in a variety of engineering problems in mechanical engineering.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Describe the planar motion of particles and rigid bodies. *Category A*
2. Apply Newton's second law and use free body diagrams to derive the equations of motion for particles and rigid bodies in planar motion. *Category A*
3. Understand work, potential energy and kinetic energy, and to use work and energy principles to obtain velocity and position, and the work done by external forces. *Category A*
4. Determine the behaviour in transient motion of a single-degree-of-freedom vibratory system from its mathematical description and determine the forced vibration of such a system subjected to constant amplitude or unbalanced excitation. *Category A*
5. Design to avoid or achieve resonance in single-degree-of-freedom mechanical models. *Category A*
6. Balance a rotating unbalanced system and calculate bearing forces for such a system. *Category A*
7. Calculate and determine the critical rotating speed of whirling of shafts. *Category A*

Syllabus:

Dynamics - *Kinematics and kinetics of particles*, rectilinear motion, plane curvilinear motion, relative motion, equation of motion, work and energy, impulse and momentum. *Plane kinematics of rigid bodies*, rotation, absolute motion, relative velocity, instantaneous centre of zero velocity, relative acceleration, motion relative to rotating axes. *Plane kinetics of rigid bodies*, force, mass and acceleration, general equation of motion, applications, e.g., four-bar linkage and slider-crank mechanisms, gear trains, work and energy, impulse, momentum, impulse-momentum equations, impact and applications, rotor imbalance and whirling of rotating shafts.

Vibration of a Single-degree-of-freedom System - Free vibration of particles, equation of motion, damping effects, forced vibration of particles, vibration of rigid bodies, energy methods, computer simulations of the free and forced vibration response of a single-degree-of-freedom system.

Laboratory Experiment:

There are two 2-hour laboratory sessions.

Typical Experiments:
1. Gear train experiment.
2. Rotating balancing.
3. Forced vibration.
4. Whirling of shaft.

Case Studies:

Typical Case Study:
Parametric design and selection to avoid resonance in a rotating system.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. F.P. Beer and E.R. Johnson, Vector Mechanics for Engineers: Dynamics, McGraw-Hill, 2004.
2. J.L. Meriam and L.G. Kraige, Engineering Mechanics, John Wiley, 2003.

3. S. Graham Kelly, Fundamentals of Mechanical Vibrations, 2nd edition, McGraw Hill, 2000.
4. W.T. Thomson, Theory of Vibration with Applications, Prentice Hall, 1993.

SUBJECT DESCRIPTION FORM

Subject Title: Linear Systems and Control **Subject Code:** ME3107

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3106 Dynamics and Vibrations
Co-requisite: Nil
Exclusion: ME3101 Dynamics and Control I
ME3102 Dynamics and Control II
ME3105 Dynamics and Control II

Objectives:

1. To introduce the mathematical modelling of physical elements in dynamic systems.
2. To provide students with a basic understanding of behaviour of first- and second-order systems due to step, ramp and impulse inputs, and concepts of time-domain specifications.
3. To introduce the basic concepts of frequency response and frequency domain specifications.
4. To introduce feedback control and its application to improve the overall system behaviour.
5. To present the basic concepts of proportional-and-integral-and-derivative feedback, and the setting of control parameters to meet the system goals.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Given a system composed of mechanical and other physical components, write the transfer function describing input-output behaviour. *Category A*
2. Given a first- or second-order transfer function, predict its step response or free response. *Category A*
3. Given a first- or second-order transfer function and a sinusoidal input, predict the gain and phase of the steady-state output as a function of input frequency. *Category A*
4. Given the frequency response data of the system, determine the parameters of its transfer function. *Category A*
5. Draw feedback system block diagram and find closed-loop transfer functions. *Category A*
6. Given a system with certain dynamic performance, describe how behaviour can be improved according to specifications such as overshoot and settling time, using some combination of parameter tuning and feedback control. *Category A*
7. Describe basic applications of proportional, integral and derivative feedbacks in control systems to improve performance or stability. *Category A*
8. Describe how changes in parameter values will affect the stability of a control system, and apply Routh-Hurwitz criterion to find the parameter range for stability. *Category A*

Syllabus:

Dynamic Responses of First-Order and Second-Order Systems - Mathematical modelling of system elements, interconnection of elements in systems by differential equations, parameters of first-order and second-order systems, system response analysis due to step, ramp and impulse inputs using Laplace transform, simulation of dynamic systems using Matlab.

Frequency Response of First-Order and Second-Order Systems - Harmonic response, Bode diagrams, frequency domain specifications, frequency response applications.

Introduction to Feedback Control - Analysis of open-loop and closed-loop systems, transfer functions and block diagrams, time-domain specifications, system stability analysis, time-domain analysis of control systems.

Feedback Control Systems - Automatic controllers, basic P, PD, PID controllers, Routh-Hurwitz stability criterion, numerical computations for the frequency-domain analysis of dynamical systems.

Laboratory Experiment:

There are two 2-hour laboratory sessions.

Typical Experiments:
1. Digital simulation of feedback control systems.
2. DC servomechanism.
3. Water level control.

Case Studies:

Typical Case Study:
Design of a feedback controller to improve the dynamic performance of a product or device.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. K. Ogata, Modern Control Engineering, Prentice Hall, 2002.
2. N.S. Nise, Control Systems Engineering, John Wiley, 2004.
3. C.L. Phillips and R.D. Harbor, Feedback Control Systems, Prentice-Hall, 2000.
4. M.R. Driels, Linear Control Systems Engineering, McGraw-Hill, 1996.

SUBJECT DESCRIPTION FORM

Subject Title: Design and Manufacturing II **Subject Code:** ME3205

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3204 Design and Manufacturing I
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To provide students in-depth knowledge and skills on the product analysis and simulation, use of CAD/CAE, manufacturing and prototyping techniques of products.
2. To provide students advanced computer modelling and finite element modelling and analysis techniques during the product design process.
3. To enhance students knowledge on environmental impact and marketing skills during the design of products and engineering components.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. To develop students with ability to identify, formulate and solve engineering problems. *Category A*
2. To develop students with ability to apply their knowledge of mathematics, science and engineering. *Category A*
3. To develop students with an ability to use the techniques, skills, and modern engineering tools, including computational tools necessary for engineering practice. *Category A*
4. To develop students with an ability to function professionally in multidisciplinary teams. *Category B*

Syllabus:

Computer-aided Analysis in Product Design (7 weeks)
- Fundamentals in Computer-aided Engineering (CAE)
- 3-D Product Analysis
- Design Optimisation Technique
- CAD and CAM integration

Integrated Products and Process Design (3 weeks)
- Concurrent Engineering
- Reverse Engineering
- Documenting of Design Process Knowledge
- Environmental Impact

- Computer-aided Manufacturing (CAM)
- Internet Applications in Product Design and Manufacture
- Process Development and DFX Strategies

Product Management and Manufacturing Competitiveness (4 weeks)
- Product Master Platform
- Manufacturing and Supply Chain Planning
- Six Sigma Technique of Quality Improvement
- Product Life-cycle Management (PLM)

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. Clive L. Dym and Patrick Little, Engineering Design: A Project-based Introduction, John Wiley & Sons, 2000.
2. George E. Dieter, Engineering Design, 3rd Ed., McGraw-Hill International Editions, 2000.
3. Michael J Etzel, Bruce J Walker and William J Stanton, Marketing, 12th Ed., McGraw-Hill, 2001.
4. Kunwoo Lee, Principles of CAD/CAM/CAE Systems, Addison Wesley Longman, 1999.
5. Vince Adams and Abraham Askenazi, Building Better Products with Finite Element Analysis, Onword Press, 1999.
6. Warren D. Seider, Product and Process Design Principles: Synthesis, Analysis, and Evaluation, John Wiley & Sons, 2004.
7. George Huang, Internet Applications in Product Design and Manufacturing, Springer, 2003.
8. D.H. Stamatis, Six Sigma fundamentals: A Complete Guide to the System, Methods and Tools, Productivity Press, 2004.

SUBJECT DESCRIPTION FORM

Subject Title: Applied Mechanics **Subject Code:** ME3301

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: AMA201 Mathematics I or equivalent
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To develop an understanding of static equilibrium and Newton's laws of motion.
2. To apply static equilibrium and Newton's Laws for solving engineering systems.
3. To promote effective mathematical and graphical communication skills.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. To understand the basics of applied mechanics. *Category A*
2. Able to solve for forces and moments on a simple structure. *Category A*
3. Formulate and solve equivalent force/couple systems. *Category A*
4. Able to communicate effectively with the support of mathematical, and graphical skills. *Category B*

Syllabus:

Fundamentals of Mechanics - Basic concepts of mechanics. Scalar and Vectors: Vector algebra and vector components. Position, Unit and Force Vector. Two and three-dimensional force systems. Moment of a force about a point. Moment of a force about a line.

Statics - Equilibrium of a particle and the associated free-body diagrams. Equilibrium of a rigid body and the associated free body diagram. Two- and three force members equilibrium in three dimensions. Simple trusses: The method of joints; the method of sections; zero-force members; the method of sections. Internal forces developed in structural members. Shear and moment equations and diagrams. Relations between distributed load, shear and moment. Theory of dry friction. Systems with friction. Wedges. Belt friction. Rolling resistance.

Equivalent Systems - Determination of the resultant concurrent forces. Equivalent force/couple systems. Centre of gravity and centroid: by composite parts; by integration. Resultant of a general distributed force system. Moment of interia of areas. Parallel-axis theorem for an area. Radius gyration of an area. Calculation of moments of areas: by composite areas; by integration. Product of inertia for an area. Principles of virtual work.

Method of Assessment:

Overall Assessment: 0.60 × End of Subject Examination + 0.40 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference book:

R.C. Hibbeler and S.C. Fan, Engineering Mechanics – Statics, SI Edition, Prentice Hall, 1997.

SUBJECT DESCRIPTION FORM

Subject Title: Mechanics of Solids **Subject Code:** ME3303

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3301 Applied Mechanics
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To introduce concepts of stress, strain and deformation.
2. To teach students the knowledge of analyzing beams under axial and torsional loads.
3. To teach students how to analyze stresses and deflections of beam structures subjected to combination of internal transverse shear and bending moments.
4. To allow students learning how to analyze beams and shells experiencing combined loads.
5. To reinforce students with effective mathematical and graphical communication skills.
6. To promote students with a systematic approach to problem solving.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to draw free body diagrams of an assembled structure and its components. *Category A*
2. Able to apply the laws of equilibrium to solve for forces and moments on a structure. *Category A*
3. Able to solve for the principal stresses in structural components subjected to a combined state of loading. *Category A*
4. Formulate and solve problems involving bending of beams and axisymmetric shells. *Category A*
5. Able to apply the laws of equilibrium to solve for the forces and moments on structures and to determine the system and distribution of internal forces in the structure. *Category A*
6. Able to analysis simple structures. *Category A*
7. Recognise the qualitative features of the stresses, strains, materials properties and geometrical properties associated with axial loading, torsion and bending and to derive stresses and deformations in a structural component due to axial load, torsion, and bending acting individually or in combination. *Category A*
8. Recognize, formulate and solve statically indeterminate structural components. *Category A*
9. Able to communicate effectively with the improved mathematical and graphical skills. *Category B*

Syllabus:

Fundamentals - Free Body Diagram. Static Equilibrium.

Mechanical Behaviour of Materials - Concept of Stress; strain; Modulus of elasticity; Poisson's ratio; Bulk modulus; Hooke's Law; Stress-strain diagram; Saint Venant's Princicple; Axial stress; Thermal stress; planar trusses; axial deformation. Torsional Stress. Torsional deformation.

Beam - Equilibrium of beams. Shear force and bending moments. Flexural stresses. Beam deflection. Discontinuous functions for beam deflection. Slope and deflection by method of superposition. Statically indeterminate systems.

Combined Loading - Transformation of stresses. Principle stresses and maximum shear stress. Mohr's circle. Thin walled pressure vessels. Cylinders and spheres under internal and external pressures. Compounded cylinder. Stress distribution in beams. Stresses due to combined loads.

Method of Assessment:

Overall Assessment: 0.60 × End of Subject Examination + 0.40 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. F.P. Beer, E.R. Johnston and Jr. J.T. DeWolf, Mechanics of Materials, 4th edition, McGraw-Hill, 2006.
2. P.P. Benham, R.J. Crawford and C.G. Armstrong, Mechanics of Engineering Materials, 2nd edition, Longman, 1996.
3. A.C. Ugural, A.C. and S.K. Fenster, Advanced Strength and Applied Elasticity, 3rd edition, Prentice Hall 1995.

SUBJECT DESCRIPTION FORM

Subject Title: Engineering Thermodynamics **Subject Code:** ME3406

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: AMA201 Mathematics I
Co-requisite: Nil
Exclusion: ME3401 Thermofluids I
ME3402 Thermofluids II
ME3404 Thermofluids I

Objectives:

1. To provide students fundamental knowledge of basic concepts and systems used in thermal science including thermodynamic laws, processes and cycles, work and heat.
2. To enable students to understand the properties of pure substances, states, phase change, and behaviour of ideal gas.
3. To enable students to understand and apply the Law of Conservation of mass, Law of Conservation of energy, First Law of Thermodynamics and Second Law of Thermodynamics.
4. To enable students to understand various power cycles, heat engine and refrigeration cycle.
5. To enable students to understand properties of mixtures and principle of air-conditioning.
6. To teach basic evaluation techniques of heat transfer processes involving conduction, convection and radiation.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Given a set of properties, find the correct phase and remaining properties for a substance. *Category A*
2. Given a physical set up, find process and compute associated heat and work transfer that is the most reasonable approximation. *Category A*
3. Given a closed thermal system, compute the heat, work transfer and change of internal energy by 1st Law of Thermodynamics. *Category A*
4. Given an open thermal system, compute the heat, work transfer and change of enthalpy by 1st Law of Thermodynamics. *Category A*
5. Competent to evaluate heat, work transfer and efficiency for ideal heat engine cycles. *Category A*
6. Able to understand and deduce work output and efficiency of power systems, engine and COP of refrigeration cycle. *Category A*
7. Given a physical construction, competent to evaluate the rate of heat transfer via conduction, convection and radiation of a one-dimensional system. *Category A*

Syllabus:

Review of Basic Concepts and Properties of a Pure Substance - Closed and open systems. Thermal properties. State and equilibrium. Temperature and the Zeroth law. Work and heat. Process and cycle. Ideal gas. Equation of state of ideal gas. Pure substance. Phase diagrams. Evaluation of thermodynamic properties.

The First Law of Thermodynamics - Conservation of mass and control volume. The first law for a control mass undergoing a process/cycle. Internal energy and enthalpy. Constant volume and constant pressure specific heats. The first law for a control volume. The steady-flow energy equation and its applications.

The Second Law of Thermodynamics - Heat engines and refrigerators. The second law of thermodynamics. Reversible and irreversible processes. Carnot cycle. Thermodynamic temperature scale. Inequality of Clausius. Entropy. The second law for a control mass/control volume. Isentropic efficiency.

Power and Refrigeration Cycles - Vapour cycles. Rankine cycle. Gas cycles. Otto cycle. Diesel cycle and refrigeration cycle.

Psychrometry and Mixtures - Dalton model. Amagat model. Wet-bulb and dry bulb temperatures. Psychrometric chart. Air conditioning.

Introduction to Heat Transfer - Introduction of three modes of heat transfer (conduction, convection and radiation) and their governing equations. One-dimensional steady state conduction in parallel slabs and cylinders. Thermal resistance. Fins and heat exchangers.

Laboratory Experiment:

There are two 2-hour laboratory sessions: Typical Experiments include
1. Refrigeration system.
2. Mechanical equivalent of heat.
3. Diesel engine test.
4. Heat conduction and heat convection.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. R.E. Sonntag, C. Borgnakke and G.J.V. Wylen, Fundamentals of Thermodynamics, John Wiley and Son, 2003.
2. T.D. Eastop and A. McConkey, Applied Thermodynamics for Engineering Technologists, 5th edition, Pearson, 1993.
3. K. Wark, and D. Richards, Thermodynamics, 6th edition, McGraw-Hill, 1999.
4. K.D. Hagen, Heat Transfer with Applications, Prentice Hall, 1999.
5. F.D. Incropera, and D.P. Dewitt, Introduction to Heat Transfer, 3rd edition, Wiley, 2001.

SUBJECT DESCRIPTION FORM

Subject Title: Fluid Mechanics **Subject Code:** ME3407

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: AMA296 Mathematics II or AMA294 Mathematics II
Co-requisite: Nil
Exclusion: ME3401 Thermofluids I
ME3402 Thermofluids II
ME3405 Thermofluids II

Objectives:

1. To teach students the formulation of conservation laws for mass, momentum and energy, and their applications to fluid mechanics.
2. To teach students the significance of dimensionless numbers and techniques of model testing.
3. To teach students the formulation of conservation laws for mass, momentum and energy, and their applications to fluid mechanics problems.
4. To teach students the internal flow and external flow phenomena and their corresponding velocity distributions, pressure distributions, losses etc.
5. To introduce the principle and characteristics of fluid machinery such as pumps and fans.
6. To teach students the equations and characteristics of compressible flows.

Student Subject Learning Outcomes:
Category A: Professional/ academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to understand the relationship between fluid pressure and hydrostatics, and their applications. *Category A*
2. Able to understand the nature of laminar flows, turbulent flows and the significance of Reynolds number. *Category A*
3. Able to deduce various important dimensionless parameters for fluid flows. *Category A*
4. Given practical situations and flow measurement devices, competent to apply continuity equation and Bernoulli's equation to deduce velocity and pressure at different positions. *Category A*
5. Able to apply momentum equation and steady flow energy equation to solve simple flow systems. *Category A*
6. Competent to calculate the drag of a fluid flow over a flat plate, and pressure loss in ducts and pipes. *Category A*
7. Able to understand the principle of fluid machinery. *Category A*

Syllabus:

Basic Concepts **-** Fluid properties, viscosity and shear stress. Newton's Law of viscosity, simple viscometer, compressibility, Newtonian and non-Newtonian fluids.

Pressure Distribution in a Fluid - Fluid pressure, Pascal's law, pressure-height relation, manometry, forces on submerged surfaces and buoyancy, force vortex and free vortex motion.

General Description & Equations of Motion of Fluid Flow - Flow: steady and unsteady, uniform and non-uniform, incompressible and compressible, laminar and turbulent flow, Eulerian and Langrangian descriptions, streamline and streamtube, Euler equation and Bernoulli equation. Pitot and Pitot-static tubes, Venturi meter and orifice; Momentum Equation and Energy Equation; Pumps systems, pipe friction and losses.

Dimensional Analysis - Principle of dimensional homogeneity. Buckingham π theorem. Dimensionless groups and their physical significance. Flow similarity and model testing.

Conservation Equations - Continuity equation; Navier-Stokes equations; Energy equation; Exact solutions of N-S equations: Couette flow; Poiseuille flow; Couette-Poiseuille flow; Hagen-Poiseuille Flow through a Pipe. Examples of solving N-S equations by CFD software and numerical simulation models.

Internal Flow - Exact solution for fully developed laminar flow in a pipe, Darcy's law; entrance length, Reynolds experiment and turbulence; Moody chart, frictional and minor losses, design for pipes in parallel and in series.

External Flow - Viscosity and viscous stress, laminar boundary layer over a flat plate; effects of adverse pressure gradient, concepts of flow separation, and transition to turbulence, velocity profiles; characteristics of flow over bluff bodies and particles, lift, friction and profile drag; boundary layers theory, boundary layer disturbance, displacement and momentum thicknesses, momentum integral equation, laminar boundary layer profiles, skin friction coefficient, turbulent boundary layers, power law and laws of walls.

Applications on Fluid Machinery - Dynamics of flow over an airfoil and through a cascade, Euler equation for turbo-machinery, characteristics of fans and pumps;

Compressible Flows - Review of Thermodynamics, propagation of sound waves. Isentropic flow equations. Mach cone. Subsonic and supersonic flows nozzles. Normal shock waves and oblique shock waves.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. Y. A. Cengel, J. M. Cimbala, Fluid Mechanics (Fundamentals and Applications) McGraw-Hill, 2006.
2. F.M. White, Fluid Mechanics, McGraw-Hill 2003.
3. J.F. Douglas, J.M. Gasiorek and J.A. Swaffield, Fluid Mechanics, 4th edition, Pearson, 2001.
4. M.C. Potter, and D.C. Wiggert, Mechanics of Fluids, Prentice-Hall, 1991.

SUBJECT DESCRIPTION FORM

Subject Title: Project – Design Realization **Subject Code:** ME3901

Number of Credits: 2 **Hours Assigned:** 28 hours

Pre-requisite: Nil
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To provide students with an opportunity to integrate engineering sciences, design and manufacturing technologies to solve engineering design problems.
2. To apply CAD/CAE/CAM systems to engineering design projects.
3. To practise material selections and structural analysis for mechanical parts.
4. To practise data collection and analysis using different measurement equipments and software packages.
5. To practise cost control and failure analysis in integrated design and manufacturing projects.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. To develop students with an ability to identify, formulate and solve engineering problems. *Category A*
2. To develop students with an ability to apply their knowledge of mathematics, science and engineering. *Category A*
3. To develop students with an ability to design and conduct experiments, as well as to anlayze and interpret data. *Category A*
4. To develop students with an ability to use the techniques, skills, and modern engineering tools, including computational tools necessary for engineering practice. *Category A*
5. To develop students with an ability to work professionally in general mechanical systems, including the design and realization of such systems. *Category A*
6. To develop students with an ability to communicate effectively. *Category B*

Syllabus:

Design Process and Methods - Descriptive and prescriptive design process models, concept selection technique, clarifying objects, establish functions, setting requirements, generating alternatives, evaluating alternatives and improving details, quality function deployment, failure mode and effect analysis, safety, legal, economics and environmental protection considerations.

Common Mechanical Components - Design of common mechanical components: keys, couplings, fasteners, power transmission components, bearing and seals, infinite life design, safe-life design, fail-safe design, and damage tolerance design.

Materials Selection for Engineering Design - Metallic and non-metallic, ferrous and non-ferrous, considerations: function, strength, manufacture and cost, materials selection process and method, value analysis.

Computer-aided Design and Manufacturing – Applications of CAD/CAM in engineering projects.

Design Modeling and Analysis - Parametric and variational CAD modeling, feature-based product modeling, definition and type, design analysis and optimization.

Projects/Case-Studies/Laboratory-work/Assignments

The projects will be carried in groups each consisting of three to six students so as to promote the spirit of teamwork. On completion of the project, each student from the group would be asked to give an oral presentation on their projects. Marks on their oral skill and technical contents were given to each student.

Project Examples:
Fan Design - Focus on the basic fluid dynamic principles and theory used in fan design and the important parameters. The students have to go through the basic project life-cycle of concept, design, implement and handover in design the fan. The design of the fans is of open-ended nature. The group can investigate and select the applications of the fan they want to design. The students should propose their own specifications such as flow rate, pressure, speed and size of the fan they want to design. Detailed design drawing and solid modeling should be submitted. Additional marks will be given for manufacturing the fan and test their performance. The students have to search the performances, size and shape of a real-life fan used in the industry and compare with their design.

Vibration isolation and absorption – The objectives of this project are (1) To familiarize with the design of suspension system in vehicles and machineries. (2) To apply the theory of mechanical vibration in designing machine mountings with vibration isolation function. (3) To design vibration absorbers for absorbing vibration from machineries. Students are encouraged to design suspension systems or vibration absorbers for small machines such as air-conditioners and washing machines which they can found in their daily lives. They need to study the relevant theories and solve a real-life vibration problem. Experimental testing will be done to test the performance of the suspension system or vibration absorbers designed and made by the students.

Design of a Power Transmission System - The objectives of the project are (1) Bring together the individual mechanical components of a mechanical, gear-type power transmission into a unified, complete system. (2) Resolve the interface questions where two components fit together. (3) Establish reasonable tolerances and limit dimensions on key dimensions of components, especially where assembly and operation of the components are critical. (4) Verify that the final design is safe and suitable for its intended purpose. (5) Add details to some of the components that were not considered in earlier analyses. The lecturer will present basic information about the functions and design requirements for the power transmission for an industrial saw that will be used to cut tubing, establish a set of criteria for evaluating design decisions, and implement the design tasks. The saw will received some hp from the shaft of an electric motor rotating at certain rpm. The drive shaft for the saw should rotate at some specified rpm. The students are required to investigate the problem and recommend practical solutions to remedy the situation.

The study should cover an analysis of (1) Design details of reducer (gear design). (2) Material selection for shafts. (shaft design). (3) Bearing mounting on the shafts and in the housing. (bearing design). (4) Flexible couplings and keys. (coupling and key design).

Burner Design and Analysis - The objectives of the projects are (1) Identify the design elements of a burner; (2) Identify different types of flames; (3) Understand how heat is transferred from a flame to an object and the factors affect the heat transfer; (4) Design different burner heads; (d) Conduct experiments to compare the heating efficiency of different burner heads; (e) Conduct experiments to measure the pollutants emitted during the combustion process and compare the pollutants generated by different burners. The lecturer will present the basic concepts of combustion and heat transfer. The students are required to generate different concepts of burners. Feasible designs will be fabricated and tested for comparison of heating efficiency and pollutant emissions. Through this project, the students are able to appreciate the design elements of a burner and learn the experimental methods for assessing the performance and emissions of a burner system.

Method of Assessment:

Overall Assessment: 1.0 × Continuous Assessment

Reference books:

1. G. Dieter, Engineering Design, 3rd edition, McGraw-Hill, 2000.
2. K. Hurst, Engineering Design Principles, Arnold, 1999.
3. A. Ertas and J.C. Jones, The Engineering Design Process, 2nd edition, John Wiley, 1997.
4. C.L. Dym, Engineering Design, A Project-based Introduction, John Wiley, 2000.
5. A.M. Law and D.W. Kelton, Simulation Modeling and Analysis, McGraw-Hill, 2000.
6. A.I. Kathryn, Reverse Engineering, McGraw-Hill, 1996.

SUBJECT DESCRIPTION FORM

Subject Title: Numerical Methods **Subject Code:** ME3905

Number of Credits: 2 **Hours Assigned:** Lecture 24 hours
Tutorial 4 hours

Pre-requisite: AMA201 Mathematics I or equivalent
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To enable students to understand, formulate simple engineering problems and use computational methods to solve typical engineering problems.
2. To teach students to solve non-linear equations, simultaneous linear algebraic equations and eigenvalue problems in engineering problems.
3. To enable students to apply interpolating polynomials, interpolation using splines, and least-squares regression for curve fitting and plotting experimental data.
4. To teach students numerical differentiation and numerical integration for engineering problems.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to solve non-linear equations in engineering by computer software such as Matlab. *Category A*
2. Able to solve sets of simultaneous linear algebraic equations by matrix inversion using Matlab, Cramer's method and Gaussian elimination. *Category A*
3. Able to solve eigenvalue problems and find the natural frequency with modes of vibrations of mechanical systems. *Category A*
4. Able to apply interpolating polynomials, interpolation using splines, and least-squares regression for curve fitting and plot experimental data. *Category A*
5. Able to use numerical differentiation and numerical integration for simple engineering problems finding volume flow rate and momentum thickness. *Category A*

Syllabus:

Introduction to Mathematical Meodelling and Computational Methods - Mathematical & numerical modelling and applications of the commercial software packages such as MATLAB. Limitation, validation and sources of errors. Functions and plotting using Matlab.

Computer Solution of Non-linear Equations – Bracketing Methods. Bisection Method, Open Methods. Bisection Method, Open Methods. Newton-Raphson Method. Secant Method.

Simultaneous Linear Equations **-** Solving simultaneous linear equations by Matrix Inversion. Cramer's Rule, Gauss Elimination, Gauss-Jordan Elimination. Engineering applications and choice of methods.

Eigenvalue Problems **-** Standard and General Eigenvalues Problems. Methods of solving Eigenvalue problems. Applications in vibrations and Model Analysis.

Curve Fitting and Interpolation **-** Collocation-Polynomial Fit. Lagrange Interpolation. Newton's Divided-Difference Interpolating Polynomials. Interpolation using splines. Least-Squares Regression.

Numerical Differentiation and Integration **-** Taylor's series expansion, difference equations, Trapezoidal rule, Simpson's rule. Applications of numerical differentiation and integration in heat transfer and fluid flow problems.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer programs using high-level Language such as MATLAB should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Group mini-project will be assigned with individual presentation. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. S.C. Chapra and R.R. Canale, Numerical Methods for Engineers, McGraw-Hill, 2006
2. S.S. Rao, Applied Numerical Methods for Engineers and Scientists, Prentice-Hall, 2002.
3. A. Biran and Moshe Breiner, Matlab for Engineers, Addison Wesley, 1995.
4. D.M. Etter, Engineering Problem Solving with Matlab, Prentice-Hall, 1997.

SUBJECT DESCRIPTION FORM

Subject Title: Advanced Numerical Methods for Engineers **Subject Code:** ME4905

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3905 Numerical Methods
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To enable students to understand, formulate advanced engineering problems and use computational methods to solve typical engineering problems.
2. To teach students to solve complex non-linear equations, simultaneous linear algebraic equations and eigenvalues problems common in engineering problems.
3. To teach students to solve ordinary differential equations common in engineering problems.
4. To teach students to solve unsteady heat and fluid flow problems by finite different method.
5. To enable students to understand the basic theory of finite element method.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to formulate advanced engineering problems by mathematical modelling. *Category A*
2. Able to solve sets of simultaneous linear algebraic equations common in engineering. *Category A*
3. Able to use Euler and Runge-Kutta methods in solving simple engineering problems such as motion of particles and flying objects. *Category A*
4. Able to solve unsteady heat and fluid flow problems by finite difference method. *Category A*
5. Able to solve boundary value problems by finite difference method. *Category A*
6. Able to understand the basic theory of finite element method so that they can choose appropriate elements, mesh sizes and solvers for simulation. *Category A*

Syllabus:

Computer Solution of Non-linear Equations and Simultaneous Linear Equations - Roots of polynomials. Solving of simultaneous linear equations by Matrix Inversion using modern software, Gaussian-Seidal method. Special matrices. Mathematical modeling of engineering problems. Curve fitting, non-linear regressions, Fourier approximations and interpolation using modern software.

Numerical Differentiation, Integration and Ordinary Differential Equations - Difference Equations, Ordinary Differential Equations with initial conditions, Euler's Method, Heun's

method and Runge-Kutta methods. Aplications of Runge-Kutta method in solving engineering problems such as motion of particles. Stiff equations.

Finite Difference Method - Finite differences for elliptic equations and parabolic equations. Initial-and boundary-value problems: discretization of differential equations into linear equation sets; Explicit and implicit methods. Solving of transient heat conduction and fluid flow problems.

Finite Element Method - Finite elements for elliptic systems and boundary-value problems: Basic theory, discretization, interpolation function, formulation of element characteristic matrices and incorporation of the boundary conditions and solving the final matrix equation through examples in one-dimensional and two dimensional inviscid flow and heat conduction problems.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer programs using high-level Language such as MATLAB and should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Group mini-project will be assigned with individual presentation. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. S.S. Rao, Applied Numerical Methods for Engineers and Scientists, Prentice-Hall, 2002.
2. A. Biran and Moshe Breiner, Matlab for Engineers, Addison Wesley, 1995.
3. S.S. Rao, The Finite Element Method in Engineering, Pergamon Press, 1989.
4. D.M. Etter, Engineering Problem Solving with Matlab, Prentice-Hall, 1997.
5. S.C. Chapra and R.P. Canale, Numerical Methods for Engineers, McGraw-Hill, 2006.
6. J.D. Anderson, Computational Fluid Dynamics, McGraw-Hill, 1995.
7. D.W. Pepper and J.C. Heinrich, The Finite Element Method, Hemish Publishing Corp., 1992.

SUBJECT DESCRIPTION FORM

Subject Title: Capstone Project – Group based **Subject Code:** ME4908

Number of Credits: 6 **Hours Assigned:** 84 hours

Group Size: 3 students per group **Semester:** Semesters 1 and 2

Pre-requisite: ME3106 Dynamics and Vibrations
ME3107 Linear Systems and Control
ME3205 Design and Manufacturing II
ME3303 Mechanics of Solids
ME3406 Engineering Thermodynamics
ME3407 Fluid Mechanics
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To provide students with an excellent opportunity of in-depth exploration of a particular topic in mechanical engineering.
2. To teach students how to apply the general engineering sciences and fundamentals in solving an open-ended real-world engineering technical problem with a critical manner.
3. To further develop students' creativity and overall skills of problem formulation, development of appropriate solution methods, design and implementation of a final chosen solution.
4. To develop and strengthen students' oral and written presentations of the project findings and recommendations.
5. To practice data collection and analysis using different measurement equipments and software packages.
6. To engage students in a team setting to horizontally integrate all mechanical engineering knowledge that they have learnt in a comprehensive design and engineering final year project.
7. To teach how to make good oral presentation and report writing.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Students are able to select an appropriate concept and clarify the objectives in the final year project. *Category A*
2. Students are able to conduct literature search including patents, books, archived publications and product catalogues, and to perform the state-of-the-art and benchmark studies. *Category A*
3. Students are able to articulate the results and findings with scientific and logical arguments. *Category A*
4. Students are able to evaluate the potential impact of their designed solution on performance, safety, cost and environment. *Category A*
5. Students are able to participate and lead in a multi-functional team. *Category A*

6. Students are able to take into account of safety, legal, environmental protection considerations in an engineering project. *Category A*
7. Students are able to communicate their project work to sponsors (if any), supervisors, other peer teams, and even non-technical audience. *Category A*
8. Given an open-ended real-world engineering problem, the students are able to develop a set of appropriate assumptions and exercise engineering judgement to formulate the problem and suggest a practical solution. *Category B*
9. Students are able to apply appropriate engineering tool (analytical, experimental, and/or computational) for carrying out tasks in the development and implementation of a designed solution with a critical approach. *Category B*
10. Students are able to identify a set of critical variables for the given engineering problem, derive the governing equations and optimize the design solution. *Category B*
11. Students are able to design, plan and carry out scientific and engineering experiments (physical tests and/or computer numerical simulations) to prove the feasibility of their designed solutions. *Category B*

Syllabus:

A project group consisting normally of three students will be expected to complete a substantial project of a major mechanical engineering task.

Method of Assessment:

Overall Assessment: 1.0 × Continuous Assessment

Assessment (performance of each student should be assessed individually by the supervisor, the peers, a second assessor, and the examination panel) according to:

Total: 25%

- General attitude, initiative, design and analysis, and work accomplishment according to the criteria as stated above (assessed by the supervisor).
- A group interim report with oral presentations may be required on the progress of the project (assessed by the supervisor)

Total: 50%

- A formal written report at the end of the study, efforts from other members in the same project group should be clearly acknowledged (25% assessed by the supervisor and 25% assessed by the second assessor)

Total: 25%

- Group and individual oral presentation and examination together with the formal written report (assessed by the examination panel with project coordinator as the chairman)

SUBJECT DESCRIPTION FORM

Subject Title: Manufacturing and Prototyping

Subject Code: ME4205

Number of Credits: 3

Hours Assigned: Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3205 Design and Manufacturing II
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To teach the students to understand the fundamentals of manufacturing and prototyping for product design and development.
2. To teach the students to gain practical experience in manufacturing and prototyping for product design and development.
3. To teach the students to develop ability to apply up-to-date technology in manufacturing products with considerations of safety and environmental factors.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to describe the principle and operation of common manufacturing and rapid prototyping processes for product development. *Category A*
2. Skilful to decide on the use of appropriate manufacturing processes in the manufacture of a product at the design stage. *Category A*
3. Skilful to develop a prototype with modern prototyping techniques. *Category A*
4. Competent in applying up-to-date technology in manufacturing products with considerations of safety and environmental factors. *Category B*
5. Competent in applying the reverse engineering process for product development. *Category B*
6. Able to appreciate and report on the common practice in the product development industry. *Category B*

Syllabus:

Advanced Manufacturing Process
- Working Principle and Operation of Conventional and Modern Manufacturing Processes for Product Development.
- Tolerance and Processes for Precision Production.
- Hot Metal Processing, Metal Cutting Processes, Laser Cutting, Water Jet Cutting Technology, Precision Metal Removal.
- Plastic Processing.
- Manufacturing Process of Advanced Composite Materials.

- Advanced Manufacturing Techniques (Physical and chemical vapour deposition (PVD and CVD) processes, photo-chemical machining, precision casting …).
- Advanced Surface Finishing Technology.

Rapid Prototyping Technology
- Rapid Prototyping Processes and Interfacing.
- Rapid Tooling.
- Safety and Environmental Control in RP.
- Reverse Engineering (Application filed and prospect of RE, steps in RE, technologies applied in RE, 3D scanning and digitising).

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. R. Budde, Prototyping: An Approach to Evolutionary System Development, Springer-Verlag, Berlin, New York, 1992.
2. B. Benhabib, Manufacturing: Design, Production, Automation and Integration, Marcel Dekker, 2003.
3. P.N. Rao, CAD/CAM Principles and Applications, McGraw Hill, 2002.

SUBJECT DESCRIPTION FORM

Subject Title: Advanced Materials for Design and Technology

Subject Code: ME4206

Number of Credits: 3

Hours Assigned: Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3302 Engineering Materials
ME3303 Mechanics of Solids
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To provide advanced knowledge on the design and development, processing, applications and structural evaluations of advanced materials and structures.
2. To provide advanced knowledge on the principle and applications of smart materials for product design.
3. To provide advanced knowledge on the consideration of environmental impacts for product design, aircraft and aerospace structures and environmentally friendly products.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to appropriately apply advanced materials and technology in the process of designing infrastructures, toys, home appliances, environmentally-friendly products/structures. *Category A*
2. Understand the mechanics of composites and smart materials and apply them in the product design process. *Category A*
3. Understand the limitations and constraints by using advanced materials at different environments. *Category B*
4. Able to design innovative products/structures using smart materials and intelligent technology. *Category B*
5. Able to consider environmental factors during the product design process. *Category B*

Syllabus:

Advanced Composite Materials - Design and mechanical performance; Lamination theory; The rule of mixtures; Design for aircraft and aerospace structures; Porous/Sandwich structures for noise reduction; Environmentally–friendly composites; Sandwich structures; Composite manufacturing process; Recycling advanced composites; Environmental impact.

Smart Materials and Structures and Integrated Systems - Shape memory alloy (SMA) sensors and actuators; Hysteresis loop; Constitutive models; Active piezo-electric actuators;

PVDF; Magnetostrictive materials; Dynamic control of smart structures; Bio-compatibility; Embedded sensor technology.

Nano-structural Materials - Carbon nanotubes and their composite structures; Nanoclay/polymer composites; Superhard particles for wear resistance; Micro-electro-mechanical (MEMs) and Nano-electro-mechanical (NEMs) devices.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. Zafer Gurdal, Raphael T. Haftka and Prabhat Hajela, Design and Optimization of Laminated Composite Materials, John Wiley & Sons, 1999.
2. I. Chopra, Review of State of Art of Smart Structures and Integrated Systems, AIAA Journal. 2002; 40(11): 2145-2187.
3. V. Birman, Review of Mechanics of Shape memory Alloy Structures, Appli. Mech. Rev., 1997. 50(11): 629-645.
4. Michael CY Niu., Airframe Structural Design, Conmilit Press Ltd., 1988, Hong Kong.
5. Don E. Bray, Nondestructive Evaluation: A Tool in Design, Manufacturing and Service, Boca Raton, Fla.; CRC Press, 1997.
6. A. Brent Strong. Plastics: Materials and Processing, 2nd Ed., Prentice-Hall, 2000.
7. Sergey Edward Lyshevski, MEMS and NEMS : Systems, Devices, and Structures, Boca Raton, Fla.: CRC Press, 2002.
8. Facing up to the Recycling Challenge, Reinforced Plastics, Elsevier, Monthly Periodocal, 2001.
9. David A. Steenkamer and John L. Sullivan, On the Recyclability of a Cycle Thermoplastic Composite Materials, Comp. Pt. B. Engg., 1998; 29: 745-752.
10. Net composites: http://www.netcomposites.com
11. Composites News: http://www.compositesnews.com

SUBJECT DESCRIPTION FORM

Subject Title: Computer-Aided Technology for Design **Subject Code:** ME4208

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3205 Design and Manufacturing II
Co-requisite: Nil
Exclusion: ME4203 Product Design and Management

Objectives:

1. To provide students advanced knowledge on the computer-aided related technologies for product design and development.
2. To provide students advanced knowledge on the principles and applications of computer-aided modelling and analysis.
3. To provide students advanced knowledge on the use of computer-aided techniques and software to solve structural, stress, heat transfer and dynamic problems.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to use the computer-aided techniques to facilitate the process of product design and development. *Categories A and B*
2. Understand the interface among CAD, CAE and CAM during the product design process by using up-to-date software. *Category A*
3. Competent in identifying a set of design variables and the governing equations to analyze a conceptual design. *Categories A and B*
4. Able to optimise the mesh size and type and apply appropriate types of boundary constraints in the CAE process. *Category A*
5. Competent to analyse and optimise a design with the aid of modern CAE software. *Categories A and B*

Syllabus:

Computer-aided Modelling
- Geometric Models of Products
- Mathematical Modelling
  - Curve Modelling
  - Surface Modelling
  - Solid Modelling
- 3-D Product Analysis
- Modelling and Simulations

- Product Animation

Design Analysis and Evaluation
- Finite Element Modelling and Analysis
  - Modelling Techniques
  - Mesh Types
  - Boundary Constraints
  - Material and Property Types
- Mathematical Modelling
- Mechanical and Thermal Stress Analyses
- Dynamic Response
- Product Optimizations (Size and Shape)
- Non-linear Stress Analysis

CAD/CAE/CAM Integration
- Interface between CAD/CAE/CAM
- Applications of CAD/CAE/CAM

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. Michael E. Mortenson, Geometric Modeling, 2nd Ed. John Wiley & Sons, 1997.
2. Kunwoo Lee, Principles of CAD/CAM/CAE System, Addison-Wesley Longman, 1999.
3. Vince Adams and Abraham Askenazi, Building Better Products with Finite Element Analysis, Onword Press, 1998.

SUBJECT DESCRIPTION FORM

Subject Title: Development of Green Products **Subject Code:** ME4211

Number of Credits: 3 **Contact Hours:** 42

Pre-requisite: ME3205 Design and Manufacturing II
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To provide students with the concepts of green products with design.
2. To introduce the energy and resource saving products, while giving careful thought on environmental issues in product development and planning.
3. To provide students with the knowledge in the development of green products and procurement of green materials.
4. To introduce students with the knowledge of environmental assessment for evaluating the green products.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to design a new product to address a market need by considering the green product concept, energy and resource issues, manufacturing processes and environmental factors. *Category A*
2. Able to apply knowledge of mathematics, material engineering and environmental assessment to analyze the effectiveness and environmental-friendliness of a green product design via analytical and computational approaches. *Category A*
3. Able to understand and apply the approach of design for sustainability in product design. *Category A*
4. Able to work effectively as a member and apply project management technique in the capacity of a team leader to complete a multi-disciplinary project in green product design. *Category B*
5. Able to appreciate the state-of-the-art green product design and present a design project via oral presentation and written report. *Category B*
6. Able to recognize the need to develop the ability of life-long learning. *Category B*

Syllabus:

Concept of Green Product with Design - Natural resource, material and energy conservation. Pollution prevention. Environmental impact on packaging, packaging materials, durability, repairability recyclability, and waste emissions. Life cycle impact assessment. Eco-labelling and

energy-labelling product programmes. User's perception, social and cultural preference on green product design. Green product aesthetics and semantics.

Green and Sustainable Product Development Processes - Concept of green and sustainable product development: product design, planning and innovation for environment. Product development processes and flows. Product development of organizations and functions. International environmental management standards.

Green Procurement of Materials - Material assessment and survey. Green procurement evaluation criteria. Evaluation of materials and suppliers.

Environmental Assessment of Green Products - Criteria on the global warming, stratospheric ozone depletion, photochemical ozone formation, acidification, nutrient enrichment, ecotoxicity, human toxicity, resource consumption and working environment. Normalisation and weighting in the environmental assessment of products.

The Green Future - More from less. Reducing risk and nuisance. Opportunities from green technology. Green taxes. Concern for nature. Pollution and waste reduction. A positive future.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

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Teaching and Learning Approaches:

Formal Contact (Hours)	
Lecture	Tutorial/Seminar/Case Studies/Laboratory
36	6

Major Teaching/Learning Activities:

This subject covers the concept of green product with design, green and sustainable product development processes, green procurement of materials, eenvironmental assessment of green products and green future through a learning outcome-oriented approach with the aids of lecture/supplementary notes, assignments and tests.

Justification on the Appropriateness of the Teaching and Learning Methods for Aligning with Intended Outcomes:

1. The lectures and tutorials are aimed at providing students with an integrated knowledge required for the concept of green product with design, green and sustainable product development processes, green procurement of materials, environmental assessment of green products and green future.

2. Learning outcome-oriented approach with the aids of lecture/supplementary notes, tutorials, assignments and tests is used.

3. The mini-project/case study is aimed at enhancing the written and oral communication skills in English and team-work spirit of the students. The students are expected to apply the knowledge of environmental assessment of green products. The students are also required to participate in the mini-project/case study through literature survey, information searching and data gathering, results and discussions, report writing and presentation of the findings. Creative and innovative thinking are highly encouraged.

Justification on the Appropriateness of the Assessment Methods to Enable Valid Assessment of the Intended Learning Outcomes:

1. The assessment will comprise 50% continuous assessment and 50% examination.
2. The continuous assessment will comprise four components: one test (15%), three assignments (15%) and one mini-project (20%). The test is aimed at assessing the interim knowledge gained by the student. The assignments are aimed at assisting the students in preparation for the test and examination, and monitoring the progress and understanding of their study. The mini-project/case study is aimed at assessing the student's self-learning and problem-solving capability and communication skill in English.
3. The examination will be used to assess the knowledge acquired by the individual student for the degree of understanding in complex problems or learned topics.

Textbooks and Reference Books:

1. Burall P., Product Development and the Environment, The Design Council, 1996.
2. Fuad-Luke A., EcoDesign: The Sourcebook, Chronicle Books, 2002.
3. Ottman J.A. Green Marketing, NTC Business Books, 1998.
4. Ulrich, K.T. and Eppinger, S.D., Product Design and Development, McGraw-Hill, 2003.

SUBJECT DESCRIPTION FORM

Subject Title: Industrial Automation **Subject Code:** ME4217

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3107 Linear Systems and Control
Co-requisite: Nil
Exclusion: ME4202 Industrial Automation
ME4204 Mechatronic Systems

Objectives:

1. To teach students the mechanisms and selections of sensors, available techniques for sensor interfacing and protection circuits in automation systems.
2. To teach students the principle of analog-to-digital conversion, the importance of anti-alias filtering and the common methods of analog or digital signal transmissions.
3. To teach students the mechanics and control of industrial robots used in flexible automation.
4. To teach students the principle of industrial logic control systems used in manufacturing automation.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Understand the major components of mechatronic systems used in automation such as commonly used sensors and common techniques for sensor interfacing and protection circuits. *Category A*
2. Understand the common forms of signal transmissions, the importance to suppress transmission noise in mechatronic systems, analog-to-digital converters, anti-alias filters, and sampling rates for real-time applications. *Category A*
3. Understand the mechanisms of commonly used actuators and how to select a proper set of sensors and actuators for a practical mechatronic system. *Category A*
4. Understand various types of robots and their control systems for industrial applications. *Category A*
5. Understand industrial control logic design using ladder diagram and programmable logic controller. *Category A*
6. Understand the importance of self-learning through case studies, projects or laboratories. *Category B*
7. Improve the language and communication skills through report writing and presentation of self-learning projects. *Category B*

Syllabus:

Sensors and Actuators - Generic components for mechatronic systems in automation: sensors and transducers such as displacement sensors, force sensors, ultrasonic sensors, fibre optic devices, *etc*; actuators such as dc motors, stepper motors, piezoelectric actuators, *etc*.

Interfacing - Sensor protection circuits; Signal transmission and noise suppression; Analog-to-digital and digital-to-analog conversion; Sampling frequency; Anti-alias filtering.

Industrial Robotics – Robot geometry; Basic forward and inverse kinematics; Robot drives; Motion control; Robot Tooling; Robot applications; Economic justifications; Robot implementation.

Discrete Control Using PLCs - Relay logic; Combinational and sequential control; Minimization of logic equations; Ladder logic diagrams; Programmable logic controllers (PLCs); PLC components; Programming; I/O addresses; Timer and counters; PLC applications.

Laboratory Experiment:

There are two 2-hour laboratory sessions.

Typical Experiments:
1. Sequential control using PLC.
2. Programming and control of gantry robot.
3. Motor control systems.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. D. Shetty, and R.A. Kolk, Mechatronics System Design, PWS Publishing Company, latest edition.
2. D.M. Auslander and C.J. Kempf, Mechatronics — Mechanical System Interfacing, Prentice-Hall, Inc., latest edition.
3. W. Kleitz, Microprocessor and Microcontroller Fundamentals, Prentice-Hall, Inc., latest edition.

4. M.P. Groover, Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall, latest edition.

SUBJECT DESCRIPTION FORM

Subject Title: Environmental Degradation of Materials

Subject Code: ME4307

Number of Credits: 3

Hours Assigned: Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3302 Engineering Materials
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To provide students with the concepts and principles of environmental degradation of materials.
2. To provide students with the fundamental knowledge of protection and prevention technologies in systems design.
3. To provide students with the knowledge in material selection against environmental degradation for product development.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Understand the basic forms of environmental degradation of engineering structures and products. *Category A*
2. Be able to identify typical causes of real mechanical structures and materials degradation. *Category A*
3. Be able to analyze typical degradation problems in a quantitative way. *Category A*
4. Be able to select appropriate and economical methods for protecting engineering structures and materials against environmental degradation. *Category B*
5. Be able to select appropriate materials against environmental degradation for typical engineering systems and product design. *Category B*

Syllabus:

Significance of Environmental Degradation - Definitions and forms of environmental degradation; impacts and implications to economy and society.

Surface Examination and Testing Techniques - Surface morphology, chemistry and structure examination techniques; surface mechanical testing techniques.

Corrosion - Principles and basic theory of corrosion; effects of metal structures; forms of corrosion; corrosion rate determination; environmentally induced cracking; corrosive

environment and prevention; hydrogen embrittlement; hydride formation and cracking; corrosive erosion, fretting and wear; preventive methods.

Oxidation - Oxidation at elevated temperature; thermodynamics of oxidation; oxidation rate; effects of defects and alloying; coatings for oxidation protection.

Environmental Degradation of Polymers - Typical polymer molecules; types of polymer degradation; photodegradation; biodegradation.

Materials Selection and Design - Selection of alloys and other materials for corrosion prevention; considerations in preventive product/structure design.

Case Studies

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. Samuel A. Bradford, Corrosion Control, Edmonton, Alberta: CASTI Publishing Inc., 2001.
2. Corrosion: Understanding the Basics, Materials Park, Ohio: ASM International, 2000.
3. Denny A. Jones, Principles and Prevention of Corrosion, Prentice Hall, 1996.

SUBJECT DESCRIPTION FORM

Subject Title: Automatic Control Systems **Subject Code:** ME4308

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3107 Linear Systems and Control
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To provide students with a thorough understanding of controller design in time domain.
2. To provide students with a thorough treatment of compensators design in frequency domain.
3. To provide students with a thorough understanding of state-space modeling and analysis of dynamic control systems.
4. To provide students with a thorough understanding of feedback controller design using a state-space approach.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Design controllers to satisfy the system requirements. *Category A*
2. Understand the concepts of system compensation in feedback control system. *Category A*
3. Given the system transfer function or the frequency response data, determine the control parameters to satisfy the relative stability requirements. *Category A*
4. Design lead compensators, lag compensators and lag-lead compensators for feedback control systems given the performance specifications such as the phase margin, gain margin and the static velocity error constant using Bode diagrams. *Category A*
5. Design feedback controller for plant or process using computer tools. *Category A*
6. Model and analyze a dynamic system using a state-space approach. *Category A*
7. Understand the importance of self-learning through case studies, projects, or laboratories. *Category B*
8. Improve the language and communication skills through report writing and presentation of the self-learning project. *Category B*

Syllabus:

Time Domain Controller Design - Multi-mode controllers; Optimum controller settings; Ratio, cascade and feedforward control.

Frequency Domain Compensator Design - Nyquist criterion; Phase and gain margins; Multiple design constraints; Characteristics of lead, lag and lag-lead elements; Compensator design via Bode plots.

State-Space Representation of Dynamic Systems - State variables of a dynamic system; State differential equations; State-space form equations from transfer functions; Canonical forms and decoupled systems; Relationship between eigenvalues and system poles.

Control System Analysis Using State Variable Method - Direct numerical solution of state equation; Solution using state transition matrix; System stability; Controllability and observability.

Control System Design Using State Variable Method - State variable feedback; Direct calculation of gains by comparison with characteristic equation; Pole placement via control canonical form of state equations; Pole placement via Ackermann's formula.

Laboratory Experiment:

There are two 2-hour laboratory sessions.

Typical Experiments:
1. Twin-rotor control.
2. Inverted pendulum control.
3. DC servo control.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. N.S. Nise, Control Systems Engineering, John Wiley, 2000.
2. C.L. Phillips and R.D. Harbor, Feedback Control Systems, Prentice-Hall, 2000.
3. M.R. Driels, Linear Control Systems Engineering, McGraw-Hill, 1996.

SUBJECT DESCRIPTION FORM

Subject Title: Engineering Composites **Subject Code:** ME4310

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3303 Mechanics of Solids
Co-requisite: Nil
Exclusion: ME4305 Mechanics and Composites for Aircraft Structures
ME4306 Thermoplastics and Composite Materials

Objectives:

1. To provide students with knowledge of the mechanical behaviour of composite materials.
2. To provide students with understanding of the processing, fabrication and the influence of fabrication and environment on the properties of structural composites.
3. To be able to design with composite laminae or laminates so that students gain an appreciation of the wide design flexibility composites afford.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Knowledge of the types and properties of composites used in engineering. *Category A*
2. Knowledge in processing and fabrication of structural composites. *Category A*
3. Able to analyze the effects of various load or displacement boundary conditions by applying laminate analysis to composite structures. *Category A*
4. Able to understand the differences in matrix materials and the implications for composites as substitute materials in design to meet several competing requirements when monolithic components cannot. *Category B*

Syllabus:

Introductin to Enginering Composites - Classification and characteristics of composite materials. Mechanical behaviour of composite materials. Reinforcements. Matrix materials.

Composite Interfaces – Fibre-matrix interfaces. Interfacial properties. Stress transfer through composite interfaces.

Lamina Stress-strain Relationships - lamina and laminate theories. Transformation and prediction of elastic parameters. Load-deformation relationship.

Analysis of Continuous Fibre-Reinforced Lamina and Laminates – Macromechanical behaviour of a lamina. Macromechanical behaviour of a laminate.

Processing and Fabrication - Structural composites and their processing technology. Manufacture of laminated fibre-reinforced composite materials. Influence of fabrication and environment on properties.

Failures, Design, and Applications of Composites - Failure theories. Design optimization. Engineering applications of composites.

Method of Assessment:

Overall Assessment: 0.60 × End of Subject Examination + 0.40 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a zero score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. Ronald F. Gibson, Principles of Composite Material Mechanics, McGraw-Hill International Editions, 1994.
2. C.T. Sun, Mechanics of Aircraft Structures, John Wiley & Sons, 1998.
3. Celine A. Mahieux, Environmental Degradation in Industrial Composites, Elsevier, 2006
4. A. Brent Strong, Fundamentals of Composites Manufacturing-Materials, Methods and Applications, Society of Manufacturing Engineers, 2008

SUBJECT DESCRIPTION FORM

Subject Title: Environmental Noise **Subject Code:** ME4405

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3406 Engineering Thermodynamics
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To teach the students a basic understanding of practical aspects in environmental noise.
2. To equip the students to use a range of available techniques for the measurement, assessment and prediction of noise due to transportation and industrial noise sources.
3. To examine the noise assessment methodology which correlate with human perception in the context of legal requirements in Hong Kong.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Understand the simple sound fields and identify the noise sources and their respective mitigation measures for road and rail traffic noise. *Categories A and B*
2. Elucidate the various terms and factors involved in the evaluation of environmental and occupational noise. *Category B*
3. Understand the fundamentals of room acoustics. *Category A*

Syllabus:

Fundamentals of Noise - Sound Pressure Levels and Sound Power Levels; L_{eq} and Sound Exposure Level of Noise Events; Prediction and Measurement of a Simple Noise Source; Directivity effects.

Basic Concepts of Sound Propagation Outdoors: Refraction, Scattering, Diffraction, and Absorption of Sound in Air; Attenuation of Sound over Ground; Noise Reduction by Barriers.

Models for Room Acoustics; Reverberation time; Random incidence absorption coefficients; Noise from ventilation and air-conditioning systems; Fundamentals and techniques of sound insulation; Measurement and prediction of airborne and impact sound insulation; Noise ingression and emission from buildings.

Transportation Noise - Sources of noise and their method of mitigation for road and railway vehicles; Models for predicting road, rail and aircraft noise; Use of the Calculation of Road Traffic Noise (CRTN) in the noise impact assessment for large infrastructure projects.

Noise Assessment - Speech inference and noise annoyance criteria; Risks of hearing damages due to noise exposure; Noise criteria and noise ratings; Descriptors for determining human response to noise; Standards and legislations of controlling environmental noise in Hong Kong; Application of control noise permit in Hong Kong

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Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. M.J. Crocker, (Ed.), Handbook of Acoustics, John Wiley & Sons, 1998.
2. B.J. Smith, R.J. Peters and S. Owen, Acoustics and Noise Control, Longman Scientific & Technical, 1988.
3. P.M. Nelson, (Ed.), Transportation Noise Reference Book, Butterworths, 1987.
4. The Open University Press, Unit 11-13, T234 Environmental Control and Public Health, The Open University, 1988. (Reprint)
5. The Open University Press, Noise Block, T334 Environmental Monitoring and Control, The Open University, 1990. (Reprint with amendments).
6. L.E. Kinsler, *et al*, Fundamentals of Acoustics, Wiley, 1982.

SUBJECT DESCRIPTION FORM

Subject Title: Noise Abatement and Control **Subject Code:** ME4406

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3406 Engineering Thermodynamics
ME3407 Fluid Mechanics
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To understand the elementary noise sources, and the method to identify and analyze the type of noise source in practical engineering problems.
2. To learn the state-of-the-art in noise abatement technology, which at the present includes dissipative, reactive and active methods.
3. To solve a problem in noise abatement and control engineering by using appropriate design tools.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Understand the physics of sound wave propagation in different medium. *Category A*
2. Understand the difference between transmission loss, insertion loss and related concepts, and choose appropriate evaluation criterion for a given problem which can be either duct noise or room acoustics application. *Category A*
3. Design elementary reactive muffler and absorptive duct lining, e.g. Helmholtz resonator and expansion chamber, by analytical method and understand the assumptions involved in the analytical theory. *Categories A and B*

Syllabus:

Noise Sources and Control Strategy - Sound and its energy flux, intensity measurements for source identification. Elementary noise source mechanisms, categorization of actual noise sources in transport, product and other applications. Flow induced noise sources. Overview of control strategy for different frequency ranges.

Sound Reflection - Propagation and decay of duct acoustics modes, sound reflection by expansion chamber, and acoustic admittance of pipe systems, Helmholtz resonator, quarter-wavelength resonator, numerical simulation of reactive silencers.

Sound Absorption - Characteristics of sound propagation in porous materials, empirical formulas and numerical modelling of sound absorption materials, grazing incident sound, and performance of duct lining.

Active Noise Control - Destructive interference, sensors, actuators and controllers, concept of feedback and feedforward control.

Room Acoustic Control - Basic concepts of room acoustics modes, sound and vibration transmission in buildings, measurement of transmissions, basic techniques of sound and vibration insulation.

Mini Project - This involves the use of numerical and/or experimental methods for noise abatement in a realistic application.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. A.D. Pierce, Acoustics: an Introduction to its Physical Principles and Applications, Acoustical Society of America, Woodbury, N.Y., 1989.
2. A.P. Dowling and J.E. Ffowcs Williams, Sound and Sources of Sound, Chichester: E. Horwood, 1983.
3. L.L. Beranek, Noise and Vibration Control Engineering: Principles and Applications, Wiley, 1992.
4. D.A. Bies and C.H. Hansen, Engineering Noise Control: Theory and Practice, E & FN Spon, 1996.

SUBJECT DESCRIPTION FORM

Subject Title: Principles of Sound and Vibration

Subject Code: ME4407

Number of Credits: 3

Hours Assigned: Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3406 Engineering Thermodynamics
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To teach the underlying physics of the origin of sound, wave propagation, and the meansurement of sound and vibration.
2. To lay a solid foundation for further studies in all major aspects of noise and vibration control engineering.

Student Subject Learning Outcomes:
Category A: Professional/ academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Understand the physics of sound propagation in duct and room. *Category A*
2. Calculate the coefficients of 1D sound reflection and transmission through a junction and a flat interface of acoustic media. *Category A*
3. Understand the mechanisms of basic measurement devices for sound and vibration. *Categories A and B*

Syllabus:

Fundamentals of Sound - Fluid compressibility, wave equation, sound pressure level and sound power, addition of sounds of different frequencies, octave bands and one-third octave bands, conservation of acoustic energy flux at the absence of a mean flow.

Vibration of Continuous Systems - Vibration of string, rod, beams and plates; energy transmission through structures, natural modes, free and forced vibrations.

Sources of Sound - Radiation of sound by pistons (1D, 2D), impedance, radiation efficiency, monopole and dipole, critical frequency, sound radiation by 2D structures.

Sound Propagation - Single travelling wave and properties of standing wave, reflection of sound at pipe junctions and at interface of two media.

Sound and Vibration Measurement - Measuring systems, microphones, sound level meters, background noise, measurement of sound intensity, reverberation time and absorption

coefficient; accelerometers, calibration and mounting of accelerometers; shakers, hammers, force transducers and amplifiers; damping measurement, experimental modal analysis.

Laboratory Experiment:

1. Sound propagation in anechoic chambers.
2. Expansion Chamber for noise reduction.
3. Experimental modal analysis of a vibrating beam.

Method of Assessment:

Overall Assessment: 0.60 × End of Subject Examination + 0.40 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. L.E. Kinsler, et al., Fundamentals of Acoustics, Wiley, 2nd Edition, 1982.
2. M.P. Norton, Fundamentals of Noise and Vibration Analysis for Engineers, Cambridge University Press, 1989.
3. H. Benaroya, Mechanical Vibration: Analysis, Uncertainties and Control, Prentice-Hall, 1998.

SUBJECT DESCRIPTION FORM

Subject Title: Engine Technology **Subject Code:** ME4409

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3406 Engineering Thermodynamics
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To teach the students fundamental concepts and applications of engine technology.
2. To teach the students basic knowledge of engine fuels, and its related combustion and emissions.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to understand the general knowledge of engine components and terminology worldwide. *Categories A and B*
2. Able to understand and evaluate physical parameters of engine design and operating characteristics. *Categories A and B*
3. Competent to apply the knowledge of air-standard and real air-fuel engine cycles. *Category A*
4. Competent to apply the knowledge of thermochemistry and fuels. *Category A*
5. Able to apply the general principles of engine combustion, emissions controls and standards. *Categories A and B*

Syllabus:

Introduction - Historical perspective of engines. Engine classifications. Terminology and abbreviations. Engine components. Basic engine cycles.

Engine Design and Operating Characteristics - Engine parameters. Indicated work per cycle. Mean effective pressure. Brake torque and power. Dynamometers. Air-fuel and fuel-air ratios. Specific fuel consumption. Fuel efficiencies. Volumetric efficiency. Specific emissions and emission index. Relationships between performance parameters. Engine design and performance data. Noise abatement.

Engine Cycles - Air-standard cycles. Otto Cycle. Diesel cycle. Dual cycle. Comparison of Otto, Diesel and Dual cycles. Real air-fuel engine cycles.

Thermochemistry and Fuels - Thermochemistry. Gasoline, diesel and alternative fuels.

Engine Combustion and Emissions - Spark ignition engine combustion, ignition and burning rate analysis. Compression engine combustion, fuel injection, ignition delay and combustion rates. Engine emissions controls and standards.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is a student's full responsibility to complete the assigned problems individually except the group projects/cases and to ask any question on those assigned problems if he/she has encountered any difficulty. Any student who is found to plagiarize the work of others will be given "zero" mark for that particular assignment. Students are advised to obtain help from the subject lecturer whenever necessary.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the subject lecturer and programme leader concerned ahead of time. In the event of absence, it is the student's full responsibility to catch up on any missed assignment.

Reference books:

1. C.R. Ferguson and A.T. Kirkpatrick, Internal Combustion Engines, 2nd Edition, John Wiley & Sons Inc., 2001.
2. J.C. Guibet, Fuels and Engines- Technology, Energy and Environment, Vol. 1 & 2, Technip, Paris, 1999.
3. W.W. Pulkrabek, Engineering Fundamnetals of the Internal Combustion Engine, 2nd Edition, Prentice Hall, 2004.

SUBJECT DESCRIPTION FORM

Subject Title: Air Conditioning for Indoor Thermal and Environmental Quality **Subject Code:** ME4411

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3406 Engineering Thermodynamics
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To teach the students fundamental concepts and applications of air conditioning engineering.
2. To teach the students fundamental knowledge of indoor thermal and environmental quality.
3. To teach the students fundamental concepts and applications of refrigeration engineering.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Able to appreciate and understand the concept and components of air conditioning and refrigeration systems and applications. *Categories A and B*
2. Competent to apply the general knowledge of indoor thermal comfort and environmental health. *Category B*
3. Competent to apply the knowledge of moist air properties and conditioning processes. *Category A*
4. Competent to apply the knowledge of the heat transmissions in building envelope. *Category A*
5. Able to understand and evaluate the physical parameters which have important effects on both the heat gain and heat loss of a building. *Categories A and B*
6. Competent to apply the knowledge of heating and cooling loads required for a building. *Category A*
7. Able to identify the refrigerant properties and safety group classification. *Categories A and B*
8. Competent to apply the knowledge of refrigeration systems and cycles. *Category A*

Syllabus:

Introduction of Air Conditioning and Refrigeration Systems and Applications - Basic components of air conditioning and refrigeration systems. The complete air conditioning system. Central mechanical equipment. All-air systems, air-and-water systems, all-water systems. Unitary air conditioners. Heat pumps. Heat recovery systems. Thermal storage.

Indoor Thermal Comfort and Environmental Health - Physiological considerations. Thermal comfort indices and conditions. Hot and humid, and extreme cold environments.

Indoor Environmental Health - Terminology and standards. Health sciences. The basic concerns of indoor air quality (IAQ). Prediction of indoor air quality model. Physical agents. Methods to control contaminants. Gas and particulate removal applications.

Moist Air Properties and Conditioning Processes - Moist air and standard atmosphere. Fundamental parameters. Adiabatic saturation. Wet bulb temperature and the Psychrometric chart. Space air conditioning- design and off-design conditions.

Space Heating and Cooling Loads - Outdoor and Indoor design conditions. Heat transmission in building structures. Infiltration. Heat losses from air ducts. Auxiliary heat sources. Supply air for space heating. Source media for space heating. Heat gain, cooling load and heat extraction rate. Solar radiation. Outside and interior surface heat balance. Fenestration. Internal heat gains. Zone air heat balance. Implementation of the heat balance method. Radiant time series method. Supply air quantities.

Refrigeration - Refrigerants. Mechanical vapour-compression refrigeration cycles. Modifications to basic cycles. Reciprocating compressors. Cooling towers.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is a student's full responsibility to complete the assigned problems individually except the group projects/cases and to ask any question on those assigned problems if he/she has encountered any difficulty. Any student who is found to plagiarize the work of others will be given "zero" mark for that particular assignment. Students are advised to obtain help from the subject lecturer whenever necessary.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the subject lecturer and programme leader concerned ahead of time. In the event of absence, it is the student's full responsibility to catch up on any missed assignment.

Reference books:

1. ASHRAE Handbooks on Fundamentals 2001, Refrigeration 2002, HVAC Applications 2003 and HVAC Systems and Equipment 2004.
2. F.C. McQuiston, J.D. Parker and J.D. Spitler, Heating, Ventilating and Air Conditioning-Analysis and Design, John Wiley & Sons, Inc., 6th edition, 2004.
3. B. Stein and J.S. Reynolds, Mechanical and Electrical Equipment for Buildings, John Wiley & Sons, 9th edition, 2000.

SUBJECT DESCRIPTION FORM

Subject Title: Heat and Mass Transfer **Subject Code:** ME4413

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3406 Engineering Thermodynamics
ME3407 Fluid Mechanics
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To teach students the three modes of heat transfer and the evaluation techniques of heat conduction, convection and radiation.
2. To teach student the principle of numerical methods in heat transfer.
3. To teach students the fundamentals in mass transfer, concentration and law of diffusion.

Student Learning Outcomes:
Categories A: Professional / academic knowledge and skills
Categories B: Professional outlook and workplace skills

1. Able to understand the governing equations of heat and mass transfer. *Category A*
2. Able to understand the concept of thermal resistance and the evaluation techniques of heat conduction through parallel slabs and composite cylindrical tubes. *Category A*
3. Able to design different types of fins and heat exchangers. *Category A*
4. Able to understand forced and free convective heat transfer around plates, cylinders and spheres. *Category A*
5. Able to apply the heat transfer equations to steady and unsteady conditions using numerical techniques. *Category A*
6. Able to understand basic equations in mass transfer. *Category A*

Syllabus:

Introduction - Conduction, convection and radiation. Fourier's law. Newton's law of cooling.

Conduction - The plane wall. Insulation and thermal resistance. Radial systems. The overall heat transfer coefficient. Critical thickness of insulation. Heat-Source systems. Cylinder with heat sources. Heat transfer from extended surfaces. Unsteady conduction in slab or cylinder, Lumped-heat-capacity method.

Forced and Free Convection - Governing equation for the boundary layer. Fluid and thermal boundary layer. The relation between fluid friction and heat transfer. Flow over a flat plate. Flow across cylinders and spheres. Heat transfer in laminar tube flow with constant temperature and constant heat flux. Heat transfer coefficients for free convection of plates and cylinders.

Numerical Simulation - General differential equations for heat conduction. Energy balance method. Finite-difference solutions for differential equations of heat conduction. Explicit and implicit methods. Grid shape and size. Gauss-Seidel iteration. Accuracy and stability.

Heat Exchanger - Heat exchanger types. The overall heat transfer coefficient. Heat exchanger analysis: Use of the Log Mean Temperature Difference, parallel and counterflow heat exchangers. Heat exchanger analysis: The Effectiveness-NTU Method.

Radiation - Black body and grey body. Absorptivity and emissivity. View factors. Irradiation and radiosity. Radiation exchange in a grey enclosure.

Mass Transfer - Basic equations in mass transfer. Analogy between heat and mass transfer. Mass diffusion. Boundary conditions. Steady mass diffusion through a wall. Water vapour migration in buildings. Cooling Towers.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. Holman, Heat Transfer, 8th edition, McGraw-Hill, latest edition.
2. CenGel, Heat Transfer - A Practical Approach, McGraw-Hill, latest editon.
3. Incropera and De-Witt, Fundamentals of Heat and Mass Transfer, Wiley, latest edition.
4. Thirumaleshwar, Fundamentals of Heat and Mass Transfer, Pearson, latest edition.

SUBJECT DESCRIPTION FORM

Subject Title: Fluids Engineering **Subject Code:** ME4414

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3407 Fluid Mechanics
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To teach students the principle of rotodynamic machines applied to fan design.
2. To teach students to the phenomena of flows around cylinders and the applications in flow-induced vibrations
3. To teach students to the phenomena of flows around spherical particles and the applications in environmental engineering.
4. To teach students the basic theory and applications of computational fluid dynamics (CFD).

Student Learning Outcomes:
Categories A: Professional / academic knowledge and skills
Categories B: Professional outlook and workplace skills

1. Able to understand the principle of rotodynamic machines applied to fan design. *Category A*
2. Able to understand the characteristics and performance of different type of centrifugal fans and axial flow fans. *Category A*
3. Able to how to design centrifugal fans and axial flow fans for different applications. *Category B*
4. Able to understand the phenomena of flows around cylinders and spheres for different Reynolds number and the resulting force characteristics. *Category A*
5. Able to apply the knowledge in flow around cylinders and sphere in flow induced vibration and environmental protection devices. *Category B*
6. Able to understand basic theory in computational fluid dynamics. *Category A*

Syllabus:

Fluid Machinery - Classification. Pumps, fans, compressors and turbines. Energy equation. Euler equation.

Centrifugal Fans - Velocity triangles. Radial entry. Blade angles. Dimensionless coefficients. Reaction effect. Characteristics for infinite number of blades. Finite number of blades. Slip formulae and losses. Efficiencies. Actual fan characteristics for backward, radial & forward bladed fans. Fan laws. Design of impeller and volute. Case study.

Axial Flow Fans - Aerofoil lift/drag coefficients and angle of attack. Carpet Plot of fan blades. Ideal cascade flows. Relation of lift coefficient with blade solidity and flow deflection angle.

Pressure rise. Free vortex design. Circular arc camber line and stagger angle. Aerofoil blades with losses. Velocity diagrams and pressure for different axial flow fans. Fan operation and system. Fans in series and in parallel. Operational instability and temperature effects. Design illustration.

Flows around Cylinders - Effect of Reynolds numbers. Flow separations. Vortex shedding. Pressure coefficients. Mean & fluctuating forces. Velocity distributions: Prandtl's mixing length model. Flow-induced vibrations. Multi-cylinders. Effects of interference on flow field. Control of vortex induced vibrations.

Flows around Spheres - Forces in particle flows. Stokes' law. Trajectory modelling. Terminal velocity. Pressure variation. Gas-solid separation. Gravity settling and centrifugal separation. Cyclone. Velocity Distribution. Flows through packed particles. Fluidization. Ergun equation.

Introduction to CFD - General approaches. Pre-processing. Mesh generation. Governing equations (Solver). Post-processing. Solutions of ODE by Runge-Kutta methods: one-dimensional motion of flying objects. Introduction to Finite difference method: Difference equation for Elliptic equations, Parabolic equations, and Wave equations. Introduction to Finite volume method. Introduction to Finite element methods for fluid flow. Commercial packages: Finite element, finite difference and finite volume solvers: FLUENT, CFX etc.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. Darby, R., Chemical Engineering Fluid Mechanics, Marcel Dekker Inc., latest edition.
2. Zdravkovich, M.M., Flow around Circular Cylinders, Oxford University Press, latest version.
3. Shaw, C.T., Using Computational Fluid Dynamics, Prentice Hall, latest edition.
4. Wallis, R.A., Axial Flow Fans and Ducts, John-Wiley, latest edition.
5. Osborne, W.C., Fans, Pergamon, latest edition.

SUBJECT DESCRIPTION FORM

Subject Title: Combustion and Pollution Control **Subject Code:** ME4415

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: ME3406 Engineering Thermodynamics
Co-requisite: Nil
Exclusion: ME4401 Emission and Pollution Control
ME4404 Combustion Applications

Objectives:

To teach the students:
1. fundamental concepts of combustion phenomena and emissions in utilising different fuels.
2. to understand the formation and control of air pollutants.
3. the mathematical models of air pollutant dispersion.

Student Learning Outcomes:
Categories A: Professional / academic knowledge and skills
Categories B: Professional outlook and workplace skills

1. Able to understand the fundamental knowledge of thermodynamics and chemical kinetics of combustion. Category A
2. Competent to apply the general principles of combustion of fuels. Category A
3. Explain the mechanisms leading to the formation of different air pollutants. Category A
4. Understand the methods and principles of reducing air pollution. Categories A
5. Select appropriate methods for controlling air pollution. Category B
6. Determine the air pollutant concentration and dispersion from source(s). Categories A

Syllabus:

Thermodynamics and Chemical Kinetics of Combustion - Application of First Law of Thermodynamics. Reactant and product gaseous mixtures. Enthalpy of combustion. Adiabatic flame temperatures. Chemical and partial equilibrium. Global versus elementary reaction rates. Chemical time scales. Preignition kinetics. Global and quasi-global mechanisms. Nitrogen oxide kinetics.

Combustion of Gaseous and Vaporised Fuels - Laminar and turbulent premixed flames. Diffusion flames. Mechanisms of flame stabilisation. Explosion limits. Mechanisms of quenching, flammability and ignition.

Combustion of Liquid Fuels - Spray formation. Size distribution. Fuel injectors. Spray dynamics. Vaporisation of single droplet.

Air Pollutants and Their Formation - Formation of carbon monoxide, nitrogen oxides, unburnt hydrocarbon, soot and particulates. Measurement techniques and quantification of air pollutants.

Fuels and Emissions - Gasoline and diesel fuels. LPG, natural gas and biodiesel as alternative fuels. Oxygenated fuels. Effect of sulphur contents on diesel emissions.

Aftertreatment for Motor Vehicle and Power Plant Emissions - Two and three way catalysts. Cyclones, precipitators, filters and traps, evaluation of capturing efficiency. Scrubbers for flue gas desulphurisation. NOx reduction. Advanced aftertreatment devices/systems.

Introduction to Air Pollutant Dispersion - Chimneys, inversions and the atmosphere. Air pollutant concentration and dispersion from motor vehicles and chimneys. Street canyon effect.

Laboratory Experiments

Typical Experiment::
1. Flame stability
2. Emissions of diesel engine

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's full responsibility to complete the assigned problems individually except the group projects/cases and to ask any question on those assigned problems if he/she has encountered any difficulty. Any student who is found to plagiarise the work of others will be given "zero" mark for that particular assignment. Students are advised to obtain help from the subject lecturer whenever necessary.

Attendance of class is mandatory and a record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the subject lecturer and programme leader concerned ahead of time. In the event of absence, it is the student's full responsibility to catch up on any missed assignment.

Reference books:

1. G.L. Borman and K.W. Ragland, Combustion Engineering, McGraw-Hill, latest edition.
2. S.R. Turns, An Introduction to Combustion- Concepts and Applications, McGraw-Hill, latest edition.
3. R.J. Heinsohn and R.L. Kabel, Sources and Control of Air Pollution, Prentice Hall, latest edition.
4. N.D. Nevers, Air Pollution Control Engineering, McGraw-Hill, latest edition.

SUBJECT DESCRIPTION FORM

Subject Title: Aircraft Systems **Subject Code:** ME4502

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial 4 hours

Pre-requisite: ME3407 Fluid Mechanics
Co-requisite: Nil
Exclusion: Nil

Objectives:

To develop students' knowledge of the components and operating principles of essential mechanical and electrical systems in civil transport aircraft.

Professionals will be invited to speak on selected topics in the following syllabus, and site visit will be planned.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Demonstrate a good understanding of the principles of flight control and estimate aircraft performance during take off climb, cruise and descent. *Categories A and B*
2. Derive transmission and propulsive efficiencies for an aircraft engine. *Categories A and B*
3. Explain the need for transfer and booster pumps in the fuel systems of high-performance aircraft and estimate the maximum take-off weight. *Categories A and B*
4. Identify the flight control and utility functions to be considered in the design of an aircraft hydraulic system. *Categories A and B*
5. Explain the major electrical loads and the characteristics of modern aircraft electrical system. *Category A*
6. Describe the relationship of engine bleed air with major aircraft systems. *Category A*
7. Explain the need for cabin and avionics conditioning and outline recent advances in aircraft environmental control system design. *Categories A and B*
8. Explain the design philosophy and objective of aircraft emergency systems. *Category A*

Syllabus:

Flight Control Systems - Principles of flight control. Primary and secondary flight controls. Aircraft performance for each phase of flight.

Powerplant - Fuel efficiency. Effect of specific thrust. Specific fuel consumption and flight speed. Engine cycle and performance.

Fuel Systems - Characteristics of aircraft fuel systems. Fuel system components. Aircraft mass and payload.

Hydraulic Systems - Flight control and utility functions. Emergency power sources. Landing-gear system. Braking and anti-skid.

Electrical systems - Characteristics of civil aircraft electrical system. Electrical loads. Emergency power generation.

Pneumatic systems - Pitot-static systems. Use of engine bleed air. Bleed air control. Thrust reversers.

Environmental Control Systems - The need for cabin and equipment conditioning. Environmental control system design. Air distribution systems. Cabin pressurization.

Emergency Systems - Warning systems. Fire detection and suppression. Emergency oxygen. Explosion suppression. Passenger evacuation.

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

A record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed. Students may fail the subject if they are absent for more than 20% of all classes without good reasons.

Reference books:

1. The Rolls-Royce Book of the Jet Engine, latest edition, Rolls-Royce Ltd.
2. SAE Aerospace Information Report 5005, Aerospace – Commercial Aircraft Hydraulic Systems, issue March 2000.
3. I. Moir amd A.G. Seabridge, Design and Development of Aircraft Systems – An Introduction, First Edition, AIAA Education Series, 2004.

SUBJECT DESCRIPTION FORM

Subject Title: Aviation Systems **Subject Code:** ME4503

Number of Credits: 3 **Hours Assigned:** Lecture 38 hours
Tutorial/Laboratory 4 hours

Pre-requisite: AMA296 Mathematics II or AMA294 Mathematics II
ELC3505 English for Effective Workplace Communication I or ELC3501 English for Engineering Students or ELC3502 Professional English for Engineering Students
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To provide an overview of aviation systems to a diverse audience that has an interest in the development of careers in aviation.
2. To develop students' understanding of the aviation industry, which comprises various supporting unit systems, operating within one framework to achieve the global objectives of air transport safety and security and the unit-system objectives of operational efficiency and cost-effectiveness.
3. To develop students' understanding of the up-to-date operational concepts, technology applications and practices.

Professionals will be invited to speak on selected topics in the following syllabus, and site visits will be planned.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Explain the relationship among major aviation systems and to identify future directions of the industry, taking account of national and global events within and outside the industry. *Category B*
2. Demonstrate an understanding of air traffic management, flight standards and airworthiness services provided by regulatory bodies. *Categories A and B*
3. Understand the management operations of an international airline. *Categories A and B*
4. Understand the logistics issues to be considered in the future development of the Hong Kong International Airport. *Categories A and B*
5. Explain the key role and future plan of the Government Flying Service. *Category B*
6. Identify the quality assurance procedures adopted in aircraft maintenance organizations within Hong Kong and China. *Category B*
7. Identify the environmental impacts of aviation-related activities. *Category B*
8. Analyze the activities of various local aviation organizations in the promotion of an aviation culture in Hong Kong. *Category B*

Syllabus:

Aviation Systems - An overview of the relationship among major aviation systems such as civil aviation authorities, airlines, airports and aviation organisations.

Civil Aviation Administration - Air service agreements. Air traffic management. Search and rescue. Provision of ground and flight operations support. Flight standards. Aviation safety and accident investigation.

Managing Airline Operations - Flight planning and operations. Training of flight crew, aircraft engineers and technical support staff. Management of engineering operations. Flight simulator training.

Airport Management - Organization structure of the Hong Kong Airport Authority. Passenger and air cargo terminal operations. Provisions for general aviation activities.

Government Flying Service - Role of Government Flying Service: Search and rescue, air ambulance, police support, fire fighting, aerial survey, and general SAR Government support. Helicopter and fixed-wing aircraft maintenance.

Aircraft Maintenance - Quality assurance of aircraft maintenance. Aircraft modifications. Engine testing.

Aviation and the Environment - Aircraft noise and abatement policy. Air pollution and fuel usage.

Other Local Aviation Organizations - Hong Kong Air Cadet Corps. Hong Kong Historical Aircraft Association. Hong Kong Air Traffic Control Association. Hong Kong Aviation Club. Aviation Development Council. Guild of Air Pilots and Navigators.

Method of Assessment:

Overall Assessment: 1.0 × Continuous Assessment

All assigned homework inclusive of any computer problems should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a *zero* score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

A record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed.

Reference books:

1. Richard De Neufville. Airport Systems: Planning, Design, and Management, McGraw-Hill, 2003.
2. Alexander T. Wells and Seth B. Young, Airport Planning and Management, 5th Ed. McGraw-Hill, 2004.
3. Jon D. Fricker and Robert K. Whitford, Fundamentals of Transportation Engineering: A Multimodel Systems Approach, Prentice-Hall, 2004.
4. ICAO Journal, International Civil Aviation Organization.
5. Aviation Week and Space Technology, McGraw-Hill.

SUBJECT DESCRIPTION FORM

Subject Title: Aircraft Maintenance Engineering

Subject Code: ME4504

Number of Credits: 3

Hours Assigned: Lecture 38 hours
Tutorial 4 hours

Pre-requisite: AMA201 Mathematics I and AMA296 Mathematics II
Co-requisite: Nil
Exclusion: Nil

Objectives:

1. To introduce students the fundamental principles of reliability and maintenance engineering.
2. To provide students with practical knowledge of aircraft maintenance.

Professionals will be invited to speak on selected topics in the following syllabus, and site visit may be planned.

Student Subject Learning Outcomes:
Category A: Professional/academic knowledge and skills
Category B: Professional outlook and workplace skills

1. Demonstrate a good understanding of the major phases of aircraft equipment failures and model random failures with statistical distributions. *Categories A and B*
2. Demonstrate the knowledge to improve the reliability of a system through multiple redundancy. *Categories A and B*
3. Explain the difference between preventive and corrective maintenance and know how to implement a condition monitoring programme in accordance with HK airworthiness requirements. *Categories A and B*
4. Demonstrate the ability to deal with component failure interactions. *Categories A and B*
5. Explain the characteristics of common risk evaluation tools and the application of such tools in fault diagnostics. *Categories A and B*
6. Demonstrate an understanding of the major models used in maintenance error reduction. *Categories A and B*
7. Explain the objective and application of MSG 3 analysis. *Categories A and B*
8. Explain the need and procedure of maintenance programme optimization. *Categories A and B*

Syllabus:

Reliability and Rates of Failure - Reliability characterizations. The Bathtub curve. Random failures. The exponential distribution. Time-dependent failure rates. The Weibull distribution. The Poisson distribution.

Redundancy **-** Parallel components. Single redundancy. Multiple redundancy. Independent failure modes. Common-mode failures. Series-parallel configurations. Linked configurations.

Maintained Systems **-** Preventive maintenance. Idealized and imperfect maintenance. Corrective maintenance. Availability and maintainability. Constant repair rates. Condition-based maintenance.

Failure Interactions **-** Markov Analysis. Reliability with standby systems. Standby redundancy.

Risk Analysis & Error Reduction in Aircraft Maintenance **-** Fault tree analysis. Failure mode and effect analysis. SHEL model. Reason's model.

Aircraft Maintenance Programme Management **-** MSG 3 analysis. Aircraft repair and overhaul services. Optimisation of maintenance programmes. Low utilization programmes. Maintenance programme management. Modification and continued airworthiness aspects.

Case Studies **-** Mechanical issues (e.g. United Airliner Flight 2311). Maintenance issues (e.g. American Airlines Flight 191, Maintenance-induced Aircraft Damage).

Method of Assessment:

Overall Assessment: 0.50 × End of Subject Examination + 0.50 × Continuous Assessment

All assigned homework should be worked out independently. It is the student's responsibility to work out the problems individually and to ask questions on those problems they have difficulty with. Unless stated otherwise, no group submission or copies are permitted. If a copy is detected, a ***zero*** score will be assigned regardless of whom did the assignment. Students are advised to obtain help from the course instructor when needed.

A record of attendance will be kept. If a student anticipates being absent from class for any reason, please notify the course instructor ahead of time. In the event of absence, it is the student's responsibility to catch up on any work missed. Students may fail the subject if they are absent for more than 20% of all classes without good reasons.

Reference books:

1. HKAR-66, CAD, Hong Kong.
2. CAD 396 Registration, Certification and Maintenance of Aircraft, 1998, Civil Aviation Department, Hong Kong.
3. CAD 418 Condition Monitored Maintenance: an Explanatory Handbook, 1997, Civil Aviation Department, Hong Kong.
4. J.P. Bentley, Reliability and Quality Engineering, 2nd Ed. Addison-Wesley, 1999.