UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Engineering, Built Environment and Information Technology

POSTGRADUATE BROCHURE 2010

Department of Mechanical and Aeronautical Engineering

Departmental website address:
http://www.me.up.ac.za

Compiled by:
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1. INTRODUCTION

As part of the postgraduate programme in the Department of Mechanical and Aeronautical Engineering, engineering students may register for the BEng(Hons), MEng, PhD and DEng degrees. Candidates with BSc, BTech or equivalent qualifications may register for the BSc(Hons)(Applied Science) degree. This qualification allows the student to subsequently register for the MSc(Applied Science) degree, which may be followed by a PhD degree. Students who wish to register for modules for non-degree purposes may register for Engineering Special Postgraduate.

With this prospectus particulars pertaining to requirements, available modules and study arrangements are described in detail. The prospectus is however intended to provide information and must be read in conjunction and subordinate to the Yearbook of the University of Pretoria, specifically two volumes: *General Regulations and Information* and *Engineering*. Both these volumes are available for download as pdf documents at this link, or at http://web.up.ac.za > New Students > Yearbooks.

This prospectus is a dynamic document that may change as we approach the year 2010, or while the year 2010 progresses. Changes are recorded in a register on the last page. Students are encouraged to continually check the postgraduate web page of the department for the latest version of this brochure. In addition to the link above, the postgraduate web page can be reached via the departmental web page at http://www.me.up.ac.za >M&A Academic Programmes > Postgraduate.

1.1. Contact Information

Further enquiries with regard to postgraduate studies may be directed to the following persons:

Academic Arrangements (Department)			
Registration Module changes Administration enquiries	Ms M Calder	012 420 2096 (Tel) 012 362 5087 (Fax)	marietjie.calder@up.ac.za
Coordinator for Postgraduate Studies; Curriculum Structure, all postgraduate degrees	Prof NJ Theron	012 420 3309	nico.theron@up.ac.za
General Administration (School of Engineering)			
Applications	Ms S Steenberg	012 420 5315	stefanie.steenberg@up.ac.za
Theses/Dissertations	Ms S Steenberg	012 420 5315	stefanie.steenberg@up.ac.za
Masters, Honours	Mr J Makhasa	012 420 2142	joseph.makhasa@up.ac.za
Financial Administration			
Students accounts	Ms M Frates	012 420 4061	matty.frates@up.ac.za

Enquiries in connection with specific modules must, as far as possible, be directed to the lecturer concerned. Ms Marietjie Calder acts as Administrator of Postgraduate Studies in the department, and any enquiries which cannot be answered by the abovementioned personnel, may be directed to her.

Further information on the department and its research programmes can be obtained at the departmental web page at http://www.me.up.ac.za.

2. HONOURS DEGREES

The Department awards the following taught honours degrees: the BEng(Hons) degree in Mechanical Engineering (degree code 12240051) follows on a BEng degree, and the BSc(Hons)(Applied Sciences)(Mechanics) degree (code 12243021) follows on a BSc, a BTech or equivalent. For all honours degrees the candidate must successfully complete modules that total 128 SAQA credits (1 credit represents 10 study hours). The minimum duration is one year of full time study. Most of the postgraduate semester modules carry a weight of 32 credits, but some 16 credit modules are also offered. Normally a part time student shall complete 64 module credits per annum so that the degree may be conferred after two years. This can however be accelerated.

Candidates for the BSc(Hons)(Applied Science)(Mechanics) must do two compulsory 32 credit modules: MTV 732 Thermoflow and MSY 732 Structural Mechanics, offered in the first and second semesters of each year, respectively. In addition to these modules, BSc(Hons)(Applied Science) students can choose the other 64 credits from any of the postgraduate modules offered by the department, subject to the normal prerequisites. Part time BSc(Hons)(Applied Science) students will not be allowed to register for any other postgraduate modules in the first semester of each year before having completed MTV 732 Thermoflow, or in the second semester before having completed MSY 732 Structural Mechanics.

Most postgraduate modules are presented in blocks. This normally entails six full contact days per semester per 32 credit module. The contact days are typically in two-day blocks, spaced at roughly four week intervals. Further particulars with respect to the dates of these blocks are shown in section 13.

Apart from the lectures, students are also expected to complete assignments, which must be completed in parallel with the lecture series. Satisfactory completion of these assignments and formal tests form part of the examination entrance requirements. According to the SAQA guidelines of one credit per 10 notional hours, it is expected that a student will typically do 320 hours of work to qualify for a 32 credit module.

Note that a student may repeat any module only once. No supplementary or special examinations are granted at postgraduate level (see Eng. 19(f)(v) in the *Engineering* year book). The General Regulation G.12.5 (see *General Regulations and Information* year book) pertaining to undergraduate students who miss examinations due to unforeseen circumstances or illness, also apply to honours students with respect to all modules offered by the Department.

Postgraduate modules are by default presented in English, unless all registered students and the lecturer agree that the lectures should be in Afrikaans. All students are entitled to participate in English or Afrikaans during contact sessions or answer tests or examinations in either one of the languages. All study material will usually be available in English only.

3. MASTERS DEGREES

The department awards two research based masters degrees, namely the MEng degree in Mechanical Engineering (degree code 12250051), which follows on a BEng(Hons), and the MSc(Applied Science)(Mechanics) degree (code 12253021), which follows on a BSc(Hons)(Applied Science)(Mechanics). It is compulsory to complete the honours degree before admission to the masters degree will be considered.

Both masters degrees are awarded on the basis of 128 credits based on a dissertation and an examination covering the field of the dissertation.

Candidates must demonstrate a sound and fundamental knowledge in a specialised field of mechanical engineering science, which will normally have been formed by the focus of their honours degree course work. They will further be trained in the scientific method of work and thought processes, and have proven through supervised independent research, their ability to use scientific methods in scientific investigation.

All candidates for the masters degree must prepare and submit at least one article for publication in an ISI accredited journal (listed at http://science.thomsonreuters.com/mjl/index.html), before submitting the dissertation. This article must be based on research done for the dissertation, and must be approved by the supervisor (see Appendix 2).

4. DOCTORAL DEGREES

The PhD degree is awarded based on grounds of a research thesis and an examination covering the field of the thesis.

Candidates for the doctoral degree must prove that they have an in-depth and fundamental but also wide ranging knowledge of a specialised field in science, are trained in the scientific method of work and thinking and have in particular demonstrated their ability to apply scientific methods in a scientific investigation through independent research, making an original contribution to science.

Only candidates holding a MEng or an MSc(Applied Science) degree will normally be allowed into the doctoral programme.

All candidates must prepare and submit at least two articles for publication in an ISI accredited journal (listed at http://science.thomsonreuters.com/mjl/index.html). The research for this article must be done in collaboration with the department. Before submitting the article to the journal approval must be obtained from the supervisor (see Appendix 2).

The DEng is a doctoral degree awarded on grounds of publications and may be awarded to a candidate on grounds of exceptional and wide-ranging research work, which enjoys international recognition. In the Faculty this is interpreted as that, based on his/her research outputs, the candidate is generally and internationally recognised as a leader in his/her field.

5. ADMISSION TO POSTGRADUATE STUDIES AT THE UNIVERSITY OF PRETORIA

The procedure for admission of a student to the University of Pretoria, specifically in the Department of Mechanical and Aeronautical Engineering, is slightly different for South African citizen and for international applicants.

5.1. Applicants who are South African citizens

Before registration, prospective postgraduate students from other universities and students who have discontinued their studies at the University of Pretoria for a year or longer, must apply for admission to the University. This can be done either online or through mailing the

completed application forms and the corresponding fees, called the "paper-based application". Details of both are available on the University's web site, see http://web.up.ac.za >Apply for admission (under "Your quick links to …"). For a paper-based application the necessary forms and documentation may be requested by e-mail from csc@up.ac.za, including the applicant's name, postal address and type of application form (postgraduate). The following postal address may also be used:

CLIENT SERVICE CENTRE
UNIVERSITY OF PRETORIA
LYNNWOOD ROAD
PRETORIA
0002 SOUTH AFRICA

Applications close on 31 October or 30 April of each year, for South African citizen students planning to commence studies in the first semester of the following year or in the second semester of the same year, respectively.

Students planning to commence with postgraduate studies without interruption directly after completion of another degree at the University of Pretoria do not need to apply for admission, although they are required to indicate their intention by completing the internal application forms at Student Administration, 6th floor, Engineering Building I.

5.2. International applicants

International students wishing to apply for honours, masters or doctoral studies in the Department of Mechanical and Aeronautical Engineering at the University of Pretoria, need to take both of the following actions:

1. Apply for admission as a student at the University of Pretoria
2. Apply for admission as a postgraduate student in the Department of Mechanical and Aeronautical Engineering.

More information on these two actions are given in sections 5.2.1. and 5.2.2.

5.2.1. Application for admission as a student at the University of Pretoria

This can be done either online or through mailing the completed application forms and the corresponding fees, called the "paper-based application". Details of both are available on the University's web site, see http://web.up.ac.za >Apply for admission (under "Your quick links to …"). For a paper-based application the necessary forms and documentation may be requested by e-mail from csc@up.ac.za, including the applicant's name, postal address and type of application form (international). The following postal address may also be used:

CLIENT SERVICE CENTRE
UNIVERSITY OF PRETORIA
LYNNWOOD ROAD
PRETORIA
0002 SOUTH AFRICA

For international students, applications close on 31 August of each year.

5.2.2. Application for admission as a postgraduate student in the Department of Mechanical and Aeronautical Engineering

At the same time as submitting the application for admission as a student at the University of Pretoria, the prospective international student should submit the following documentation to the Department:

- A statement of purpose, in the prescribed format (see below)

- Copies of transcripts for all previous university studies (this may also be required by the application process described in section 5.2.1.; in that case copies should be sent to both the University's Client Service Centre and the Department)

- Copies of the applicant's capstone design and final year projects in pdf format

- A copy of the applicant's masters dissertation in pdf format (for PhD students only)

- Three letters of reference, in the prescribed format

- Rank in class document, in the prescribed format

A file containing templates that indicate the required format of the statement of purpose, the letters of reference and the rank in class document should be requested from marietjie.calder@up.ac.za or may be downloaded from the Department's postgraduate web page. The application materials (only those described in section 5.2.2) must be sent to:

The Coordinator: Postgraduate Studies
Department of Mechanical and Aeronautical Engineering
University of Pretoria
Pretoria
0002 SOUTH AFRICA

or can be scanned and e-mailed to: marietjie.calder@up.ac.za .

Original documentation will have to be submitted for inspection when the student registers at the University of Pretoria.

Prospective international students are encouraged to also visit the University of Pretoria International Students website, see http://web.up.ac.za/ > International Students.

6. ADMISSION REQUIREMENTS

6.1. BEng(Hons)

To be admitted to the BEng(Hons) degree programme, the candidate must hold a BEng degree (or equivalent) that is accredited by the Engineering Council of South Africa (ECSA) for purposes of registration as professional engineer. A candidate who holds a bachelors degree in engineering that was awarded by a university outside South Africa, where the comparable registration authority of that country accredits this degree in a similar way, while that country is a signatory to the Washington Accord, shall also be admitted to this programme. If the foreign country is not a signatory to the Washington Accord, the candidate will be admitted to this programme only if he/she, at his/her own cost, obtains clearance from ECSA (http://www.ecsa.co.za/) that his/her degree would be deemed acceptable for the purposes of registration as professional engineer in the Republic of South Africa.

6.2. BSc(Hons)(Applied Sciences)

To be admitted to the BSc(Hons)(Applied Sciences) degree programme, the candidate must hold an appropriate bachelors degree. Typical examples are a BTech degree in Mechanical Engineering, or a BSc degree in Mathematics, Applied Mathematics or Physics. A

candidate whose bachelors degree in engineering does not meet the admission requirements for the BEng(Hons) programme, may also be admitted to the BSc(Hons)(Applied Science) programme.

6.3. MEng

To be admitted to the MEng degree programme, the candidate must hold a BEng(Hons) degree (or equivalent), as well as meet the admission requirements for the BEng(Hons) degree.

6.4. MSc (Applied Sciences)

To be admitted to the MSc (Applied Sciences) degree programme, the candidate must hold a BSc(Hons)(Applied Sciences) degree (or equivalent).

6.5. PhD

To be admitted to the PhD degree programme, the candidate must hold an MEng or an MSc (Applied Sciences) degree (or equivalent). This means that the masters degree must have been a research-based degree. Candidates holding a taught masters degree may be admitted provisionally and may be required to submit a research report for examination leading to full admittance after a year.

7. ACADEMIC ADVISOR

A postgraduate student may not register unless an academic advisor for the student has been appointed. The academic advisor must be a lecturer of the Department of Mechanical and Aeronautical Engineering holding a PhD degree. In the case of a masters or doctoral student, the academic advisor would be the same person as the supervisor.

Prospective students may contact individual lecturers with a request to act as academic advisor. It is recommended that this be done by e-mail, even before applying for admission. Once the lecturer agrees, the student should notify Ms M Calder (see Contact Information). After Ms Calder has confirmed this arrangement with the lecturer, he/she will be deemed appointed. Otherwise the Coordinator for Postgraduate Studies will appoint an academic advisor when the application for admission is approved.

In the case of an honours student, the main function of the academic advisor is to assist the student in the selection of the modules for which he/she would register. It is therefore of paramount importance that the honours degree student visit his/her academic advisor before registration.

8. REGISTRATION

Online registration is available to all postgraduate students in Mechanical Engineering, who either have been registered as postgraduate students for the same degree during 2009, or have completed another degree at the University of Pretoria during 2009 and have in good time handed in the completed internal application forms at Student Administration (see section 5.1). In all other cases a paper based registration process is used. Students will receive a registration form by mail. Off campus part time students may either fax or scan and e-mail the completed registration forms, together with proof of payment of the

necessary registration fees, to Ms M Calder (see Contact Information) to complete registration. Please note details of the registration process in the sections below.

8.1. Online registration

Online registration and in particular the selection of modules must be pre-approved by the student's academic advisor. The online registration process will allow students to register only for the modules offered by the Department of Mechanical and Aeronautical Engineering, referred to as standard selection modules. The standard selection modules, however, exclude the module Independent Study MSS732. If a student chooses to register for a module(s) offered by another Department (see section 11.3) or for the module Independent Study MSS732, this must additionally be approved by the Coordinator for Postgraduate Studies (Prof NJ Theron, see Contact Information). In this case the student should first complete his/her registration for those modules that the online system allows (standard selection modules), after which he/she should send an e-mail message to his/her academic advisor requesting permission to register for the non-standard selection. The module name(s) and code(s) should be included in the e-mail. In the case of Independent Study MSS732 all relevant details (the material that will be studied, the name of the lecturer who will act as supervisor for this module, etc.) should also be included in the e-mail. The academic advisor will then forward the e-mail to Prof Theron, with a note indicating his/her approval. If he also approves, Prof Theron will forward the e-mail to the Student Administration with a request to complete the registration process.

Registration fees are payable before online registration can commence.

8.2. New students registering for BEng(Hons)

The registration form will show the student's personal information and a listing of all the standard selection modules (see section 8.1.). To register the student needs to cross out all the modules he/she chooses not to register for, sign the form, have it approved by his/her academic advisor, pay the registration fee either at the Client Service Centre or by direct deposit into the University's bank account and then hand in the registration form with proof of payment at the Student Administration on level 6 of the Engineering I building. If the student and his academic advisor have decided on non-standard selection modules, these must be filled in underneath the listing of the standard selection modules and the form must then also be approved by the Coordinator for Postgraduate Studies (Prof NJ Theron, see Contact Information).

8.3. New students registering for BSc(Hons)(Applied Sciences)

The registration form will show the student's personal information and a listing of the two compulsory modules, MTV 732 Thermoflow and MSY 732 Structural Mechanics. The student should follow the same procedure as described in section 8.2. for new BEng(Hons) students. If the student plans to do any other postgraduate modules, standard selection or otherwise, these should be filled in underneath the listing printed on the form.

8.4. New students registering for masters or doctoral degrees

The registration form will show the student's personal information and a single module listing indicating dissertation or thesis. To register the student needs to sign the form, have it approved by his/her supervisor, pay the registration fee either at the Client Service Centre or by direct deposit into the University's bank account and then hand in the registration form with proof of payment at the Student Administration on level 6 of the Engineering I building.

8.5. General

International students need to ensure that their study permits are valid before registration.

First semester registration as well as post-registration module changes must be completed as soon as possible, but not later than 12 February 2010. Students wishing to discontinue any module must not only inform the lecturer involved, but must also fill out the necessary forms at Student Administration. Students who have not formally discontinued modules by 19 February 2010 will be held financially accountable. Students may also commence their studies in the second semester. Such registrations must be finalised on or before 2 July 2010.

9. DURATION OF STUDY

A student registered for the honours degree must complete his/her study within 2 years in the case of a full-time student and in the case of a part-time student within 3 years after first registration for the degree. For a master's degree and doctoral degree, 4 years are allowed.

If a master's or doctoral student does not obtain the degree for which he/she is registered within four years, his/her registration will be terminated unless the Dean, on recommendation of the Head of Department, can be convinced that the progress was satisfactory.

10. PLAGIARISM

Students who commit plagiarism will lose all credits obtained in the plagiarised work. The matter shall also be referred to the Disciplinary Committee (Students) for a ruling. Plagiarism is regarded as a serious contravention of the University's rules and can lead to expulsion from the University. More detail is available on the departmental notice board at the link below and it is expected that all students should familiarise themselves with the content thereof:
http://web.up.ac.za/default.asp?ipkCategoryID=11426&subid=11426&ipklookid=7

11. CURRICULA

11.1. General arrangements

The following general arrangements apply to students registered for course modules:

- For either one of the two honours degrees 128 credits are required.
- For an honours degree a maximum of 32 credits from approved modules offered by other departments, may be followed.
- A full time honours student doing four 32-credit modules in a single year, may select either to do three modules in the first semester of study and one in the second, or to do two modules per semester. Spacing the modules 3:1 over the two semesters typically allows the student to get more preliminary research done towards his masters degree, during his/her honours year. Even though this research is done on an unofficial basis, it plays an important role in finishing up the masters degree at the end of the second year and in time to graduate at the April ceremony of the third year (for a student starting his/her honours programme in beginning of the first semester of the first year).
- The department retains the right to cancel any module in a certain year if too few students register for the module or if a suitable lecturer is not available because of unforeseen circumstances.

11.2. Postgraduate modules presented by the department

A list of approved modules with the semesters in which these modules are offered, is given in table 1 and the syllabi for these modules are given in section 12. The lecturers responsible for these modules, with their contact information, are listed in the timetable in section 13. In Table 1 "b" refers to a module being presented in block format and "p" to a module presented in weekly periods. These symbols appear in two columns (under 2010), indicating the two semesters: the first from end January to June and the second from July to November.

Table 1: Modules offered by Mechanical and Aeronautical Engineering

Module	Code	Credits	2010	
			1	2
Advanced Heat and Mass Transfer	MHM 732	32		p
Advanced Fluid Mechanics	MGM 732	32	b	
Advanced Vehicle Engineering	MGV 732	32	b	
Condition Based Maintenance	MIC 732	32		b
Design	MOX 732	32	b	
Finite Element Methods	MEE 732	32	b	
Independent Study	MSS 732	32	Module to be completed in 6 months	
Maintenance Practice	MIP 732	32	b	
Numerical Thermoflow	MSM 732	32		b
Reliability Engineering	MIR 732	32		b
Structural Integrity	MSI 732	32		b
Structural Mechanics	MSY 732	32		b
Thermoflow	MTV 732	32	b	
Tribology	MIT 732	32		b
Vibration	MEV 732	32	b	

11.3. Postgraduate modules presented by other Departments

Students may also consider modules from other departments. The final selection of modules must be approved by the Coordinator of Postgraduate studies in the Department of Mechanical and Aeronautical Engineering. If a student registers for a module offered by another department, it is his/her own responsibility to in advance check with that department for any special conditions and work that needs to be done before the commencement of the module in question. Such students are urged to obtain the post-graduate prospectuses of the departments concerned. The following departments could be considered:

Industrial and Systems Engineering	Ms H Potgieter	012 420 5230
Electrical and Electronic Engineering	Ms H Gouws	012 420 2190
Engineering and Technology Management	Ms T van Zyl	012 420 4605
Mathematics and Applied Mathematics	Ms Y McDermot	012 420 3550

12. SYLLABI

The syllabi given in this prospectus were compiled as accurately as possible. The department however retains the right to change these according to circumstances.

ADVANCED HEAT AND MASS TRANSFER MHM 732 (32 credits)

Introduction: General integral conservation equations (Mass, Momentum, Energy); Properties of a fluid (kinematic, transport, viscosity, thermal conductivity, mass diffusivity); Boundary conditions for viscous flow problems (conditions at solid surface, at a permeable wall, at a free liquid surface, kinetic theories; inlet and exit boundary codnitions);
Conduction: Transient and multidimensional heat conduction;
Convection: Laminar and turbulent boundary layers (The Energy Equation, Prandtl number and boundary layer thickness, heat transfer, coefficients, The Reynolds Analogy, heat transfer in turbulent boundary layers); Forced Convection (laminar and turbulent pipe flow, heat transfer and pressure drops, heat exchangers, noncircular ducts); Natural Convection in single-phase fluids and during film condensation; Turbulent flows (Mixing length and eddy diffusivity, forced flow along flat plate, flow in a tube); Condensation (laminar and turbulent film-wise condensation, forced convection); Boiling (pool, forced convection);
Heat Transfer Enhancement: Enhancement techniques, commercial applications, single-phase flow, two-phase flow, plate-and-fin extended surfaces, insert devices, internally finned tubes and annuli, integral roughness, boiling and condensation;
Heat Exchangers: Classification of heat exchangers, basic heat exchanger design methods, condensers and evaporators, shell and tube heat exchangers, heat exchanger fouling, compact heat exchangers, heat exchanger selection;
Radiation: Kirchhoff's Law, black bodies, grey bodies, gaseous radiation, solar radiation;
Mass Transfer: Mixtures, Fick's Law, transport properties of mixtures, the equation of species conservation, mass transfer at low and high rates, simultaneous mass and heat transfer;
Measurement Techniques: Thermometry, flow measurements, pressure measurements, computerised data acquisition, uncertainty analyses.

ADVANCED FLUID MECHANICS MGM 732 (32 credits)

Mathematical Preliminaries: Historical overview, scalar, vector and tensor algebra (in context of partial differential equations), Green's lemma and the Divergence theorem, Eularian/Lagrangian representations, derivative of a function, Reynolds transport theorem.
Governing Equations: Viscous compressible and incompressible flow, derivation of conservation of mass, derivation of conservation of momentum, boundary conditions, mathematical characteristics, non-dimensionalisation.
Viscous compressible and incompressible flow: Derivation of conservation of mass, derivation of conservation of momentum, boundary conditions, mathematical characteristics, non-dimensionalisation.
Exact solutions: Potential flow, Couette flow, Poiseuille flow and combined Couette-Poiseuille flow, laminar boundary layers (similarity solutions for flat plate flow).
Stability of Laminar Flows: Introduction, linearized stability, transition to turbulence, approximate prediction of transition.
Turbulent Flow: Reynolds averaged equations, two-dimensional turbulent-boundary-layer equations, velocity profiles, turbulent flow in ducts, flat plate flow, turbulence modelling.

ADVANCED VEHICLE ENGINEERING MGV 732 (32 credits)

The aim of the Advanced Vehicle Engineering 732 course is to build on the technical foundation laid in the Vehicle Engineering 420, Dynamics 210 and Control Systems 410 modules. Basic scientific principles, as well as vehicle specific engineering knowledge

areas are applied to describe, analyse, evaluate and design vehicles and other mechanical systems. Specific knowledge of multi-body dynamics, tyres, vehicle performance, suspension systems, human factors, ride comfort and handling is applied to analyse and evaluate vehicle systems. Emphasis is on vehicle design and the use of the appropriate engineering tools in the design process. The course content includes:
Introduction to Analytical Dynamics: work and energy, constraints, principle of virtual work, D'Alembert's principle, Hamilton's principle, Lagrange's equations.
Control systems: introduction to state space methods, full state feedback design, disturbances and tracking systems, linear observers, compensator design by the separation principle, linear quadratic optimum control, Kalman filter, linear quadratic Gaussian compensator.
Tyres: Characteristics and tyre models used in simulation of ride comfort and handling. Road inputs: Classification of roads. Road profiles. Road roughness.
Suspension components: Springs. Dampers. Controllable suspension systems. Modelling aspects.
Human reaction: Human response to vibration. Driver models. Human reaction times.
Vertical vehicle dynamics (ride comfort): Vibration levels in a vehicle. Simulation of ride comfort. Effect of seat characteristics on vibration levels. Test and evaluation procedures.
Lateral vehicle dynamics (handling): Simulation of steady state and dynamic handling. Rollover propensity. Test procedures.
Computer applications: Application of computer codes in the analysis of vehicle dynamics.
Prerequisite: Knowledge of the following: Dynamics: Kinetics of systems of particles, plane kinematics of rigid bodies, moments of inertia, plane kinetics of rigid bodies, equations of motion, work-energy relations. Vibration: Single degree of freedom systems: free vibration, harmonic excitation, general excitation and multi-degree of freedom systems. Control systems: basic classical (*s*-plane) control theory.

CONDITION-BASED MAINTENANCE MIC 732 (32 CREDITS)
Theory and practical applications of condition based maintenance techniques. Pitfalls of the various condition based maintenance techniques are discussed and referred back to the relevant theory. The course highlights vibration monitoring, signal processing and interpretation, acoustic emission, wear debris monitoring, oil analysis, thermography and non-destructive testing.
Prerequisite: A working knowledge of MATLAB or Excel.

DESIGN MOX 732 (32 Credits)
The objective of the module is to enable the engineer to plan and control design and development projects.
System Engineering (70%): All aspects, from the concept phase to phasing out of the projects as well as supporting theory are covered.
Technology forecasting (10%): Explanation and application.
Project viability studies (20%): Explanation and application.
Applicable practicals and assignments are used to equip the student to apply the theory. Students conduct a techno-economic study is used to integrate the different aspects of the subject.

FINITE ELEMENT METHODS MEE 732 (32 credits)
Description: A course in the formulation and application of the finite element method in structural mechanics and dynamics.
Linear statics: Stress and the differential equilibrium equation. Weighted residual formulation for statics. Isoparametric formulation. Numerical integration. Reduced integration. Convergence, stability and accuracy. The Patch test. Membrane elements: assumed stress mixed interpolations. Axisymmetric elements. 3-D elements. Shear rigid and shear flexible beams.

Non-linear statics: Overview of non-linear effects: geometric, material and boundary conditions. Continuum mechanics: tensors, indicial notation, deformation gradients, stress and strain measures, transformations and rotations, stress-strain relationships, constitutive models. Principles of virtual work. Solution methods: direct iteration, Newton methods, incremental/iterative procedures. Lagrange engineering strains. Large displacement finite element analysis of continua: total Lagrangian formulation. Small strain plasticity: Additive decomposition, flow rule, hardening laws, continuum and consistent tangents.
Dynamics: Solution of eigenvalue problem: transformation methods, vector iteration, subspace interaction, Lanczos method. General solutions: time response, frequency response, modal truncation. Response spectrum analysis.
Prerequisite: Vibration and Noise MVR320 or equivalent, and Structural Mechanics MSY411 or equivalent. In addition, a working knowledge of either MATLAB or FORTRAN77 is required.

INDEPENDENT STUDY MSS 732 (32 credits)
This module allows a student to study a certain body of knowledge in mechanical or aeronautical engineering, as specified by a lecturer in the Department of Mechanical and Aeronautical Engineering, on an individual basis, under the supervision of that lecturer. The total volume of work that is to be invested in this module by an average student must be 320 hours. The body of knowledge studied must be of an advanced nature, at the level of the other postgraduate modules offered by the Department. Normal requirements for assessment that include the use of an external examiner apply to this module also.

MAINTENANCE PRACTICE MIP 732 (32 credits)
This module aims to bridge the gap between the theory of maintenance and its practical application in the field. It aims to equip the engineer with the insight and knowledge of tools that will help him in solving maintenance problems faced in the workplace. This understanding ranges from the insight into failure mechanisms and failure prevention to management aspects in maintenance engineering. The central theme of the module is the maximisation of maintenance's contribution to profit through the use of more efficient methods.
Course content: Systems thinking. Failure characteristics. Maintenance Economics – Budgeting and cost control. Life cycle partnering and maintenance contracting. Legal aspects and case study. Performance measurement and benchmarking. Maintenance programming – Network analysis. Maintenance plan design – a new look as RCM. Management Information Systems. CMMS and implementation. Introduction to condition based maintenance. Tribology and contamination control presented with case studies.

NUMERICAL THERMOFLOW MSM 732 (32 credits)
Fluid Mechanics and CFD preliminaries: Fluid mechanics refresher (governing equations, boundary conditions, application of inviscid, laminar and turbulent flow), methods of weighted residuals (finite element, finite volume and difference methods).
Mesh generation and boundary conditions: Types of mesh generation, structured and unstructured mesh generation and applications (inviscid flow, heat conduction etc.), boundary conditions.
Heat conduction: Governing equation, discretisation, finite approximations, solution methods (Gauss- Seidel, Tri-diagonal matrix algorithm), boundary conditions, convergence criteria.
Cartesian and curvilinear structured grids (only theory of the latter will be dealt with).
Efficient Solvers: Background, muligrid theory and detailed description of the algorithm.
Finite Volume method: Understand the governing equations, general form of the transport equations, Gauss's theorem and the finite volume discretisation.
Iterative solution algorithm: Pressure-velocity coupling, types of grids, unsteady flows, multiple phases.
Finite Volume Discretisation: Diffusion term, convection term & source term for steady flows.

Convection-diffusion problems: Boundary conditions, higher order discretisation, accuracy / stability.
Solution Algorithm for Pressure-Velocity coupling: SIMPLE, SIMPLER, SIMPLEC & PISO.
Laminar, transitional and turbulent flow: Background and theory.
Turbulence modelling and examples: Definition of turbulence, turbulence modelling approaches, turbulence models (zero-equation models, one equation, two equation, Reynolds Stress Model (RSM), Large Eddy Simulation, wall function approach), turbulence modelling guidelines.
Recent CS developments: Current state of the art in turbulence modelling etc.
Viscous boundary meshes: Background and objectives, internal and external flow, turbulence modelling considerations.

RELIABILITY ENGINEERING MIR 732 (32 credits)
Introduction to Reliability: Concepts and Definitions, Distributions.
Component Reliability: Weibull Analysis, Limitations of Weibull Analysis – When *not* to use it.
System Reliability and Availability: Reliability/Availability Modelling, The Availability Block Diagram (ABD), Cut sets, capacity constraints, m-out-of-n systems and storage capacity, Fault trees, Failure Modes, Effects and Criticality Analysis (FMECA), Montecarlo simulation.
Failure and Repair Rate Data: Reliability Engineering's Red Herring: "We don't have the data", Some data banks that are in fact useful, Data Synthesis: the method of Paired Comparisons, Paper on *The use of NERC-GADS Data in Determining Standards for System Design*, Case Study in and exercise in Data Synthesis.
Case Studies in System Failure: Selected cases from the following list, depending on the class's interests: Chernobyl, Challenger, Sergeant York, Flixborough, Bhopal, Piper Alpha, Titanic, Airspeed Ambassador, DC-10, Comet, R101, Apollo 13.
Selected Papers in Human Reliability: Study of the following papers and the conclusions drawn therefrom: 1.) Determination of Human Error Patterns: The use of Published Results of Official Enquiries into System Failures, 2.) The Use of Competitions and Challenges as a Means of Improving Operator Performance and Reliability, 3.) Large System Failures

STRUCTURAL INTEGRITY MSI 732 (32 credits)
This module aims to enable the student to apply state of the art techniques in the design, and problem solving of failures, in components and structures. Emphasis is placed on the practical application of the methods. By combining the fields of Static failure criteria, Fatigue, Fracture Mechanics and Structural Inputs into one module, the student gets a global picture of the important aspects to design for infinite life and in the solving of failure problems in practise. Case studies will form the basis to integrate the contents of the module.
The module has a practical, rather than a rigorous mathematical emphasise, as well as mechanical, rather than a metallurgical emphasise.
Contents: Static failure criteria, Loads and stresses, Fatigue analysis, low-cycle fatigue, Neuber's rule, material properties, SNP curves, local stress and strain approaches, initiation and propagation, multi-axial fatigue, cumulative damage, life prediction techniques, accelerated fatigue testing, fatigue of welded structures, service loading, statistical aspects. The effect of notches, Linear-elastic FM, Elastic-plastic FM, Fatigue crack propagation, surface defects, leak-before-break, residual stresses, R6-method (J-method), probabilistic methods, fracture control.
Mathematical models and inputs in structural mechanics, statistical methods, measurement technology, system identification, guessing inputs, generation of inputs from measurements, simulation and failures, design codes, summarising formulation.

STRUCTURAL MECHANICS MSY 732 (32 credits)
This module is compulsory for the BSc(Hons)(Applied Science) degree and may not be done as part of the BEng(Hons) degree.

Static structural analysis:
Statically determinate systems, stress-strain relations, statically indeterminate systems. Torsion. Bending: Euler beam theory, bending stress, slope and deflection, statically indeterminate beams. Buckling: stability of equilibrium, eccentric loading, initial curvature. Stress and strain transformation: Mohr's circle, principal stresses and strains. Yield criteria and stress concentration. Variation of stress and strain: equilibrium and compatibility.

Dynamics:
Plane kinematics of rigid bodies. Kinetics of systems of particles. Plane kinetics of rigid bodies, equations of motion, work-energy relations.

Vibration:
Introduction to vibration: basic concepts, classification, modelling elements. Single degree of freedom systems: undamped and damped free vibration, undamped and damped harmonic motion, non-periodic excitation, numerical integration. Multidegree of freedom systems: discretisation, eigenproblem, coordinate coupling. Vibration control: balancing, isolation, absorbers.

THERMOFLOW MTV 732 (32 credits)
This module is compulsory for the BSc(Hons)(Applied Science) degree and may not be done as part of the BEng(Hons) degree. It consolidates fundamental and applied aspects of thermodynamics, fluid mechanics, and heat transfer:

Thermodynamics:
Basic Concepts (including work, heat, reversibility, enthalpy, heat capacity, etc.); First Law; Second Law (Entropy, Heat Engines and Heat Pumps; Carnot Cycle for Ideal Gas); Third Law; Mathematical Relations of Thermodynamics (Exact Differentials and State Functions; Transformations; PVT Relationships); Reversible Processes in Ideal Gases (Isochoric, Isobaric, Isothermal, Isentropic, Polytropic); Phase-change process; Cycles in Engineering Applications (Reciprocating Engine Cycles; Vapour Power Cycles; Refrigeration and Heat Pump Cycles).

Fluid Mechanics:
Basic Concepts (e.g. liquids and gases and solids, density, viscosity, surface tension, vapour pressure, etc.);
Statics: pressure and head, static forces, buoyancy).
Fluid Flow: Uniform and Steady Flow; Real and Ideal Fluids; Compressible and Incompressible Flow; One-, two- and three-dimensional flow; Laminar and Turbulent Flow; Discharge and Mean Velocity; Continuity Equation and its Applications; Momentum Equation and its Applications; Energy Equation and its Applications; Laminar and Turbulent Flows (incompressible flows; laminar and turbulent flows; boundary layers)

Heat Transfer:
Basic Concepts;
Conduction: Fourier's Law; One -and Two Dimensional Steady -and Unsteady State Conduction.
Convection: Velocity Boundary Layer; Thermal Boundary Layer; Laminar and Turbulent Flows; Heat and Momentum Transfer; Newton's Law of Cooling; Similarity and Dimensional Approach; External Forced Convection (single-phase; phase-change); Internal Forced Convection (single-phase; phase-change) Laminar -and Turbulent Flow; Internal Flow and External Flow
Heat Exchangers: Parallel -and Counterflow; LMTD method; Effectiveness-NTU Method; Selection of Heat Exchangers

TRIBOLOGY MIT 732 (32 credits)
Friction - Theory and laws of friction, Friction behaviour of different materials. Lubrication - Lubrication and theory, Hydrodynamic lubrication, Elastohydrodynamic lubrication, Boundary lubrication. Lubricants - Physical and chemical properties of lubricants, Composition of lubricants. Wear - Wear theory, Wear mechanisms, Particle properties. Surface modification and coverings - CDD and PDD. Contamination control - Filtration, Choice of filtration limits. Design and Wear - Determining wear rates, Role of operational parameters, choice, Role and effect of material choice, Lubrication techniques. Tribological aspects of: Bearing design, Gear design, Design of sliding elements.

VIBRATION MEV 732 (32 credits)
Theoretical basis: Single-degree-of-freedom-systems: free vibration, forced response, damping models, response properties. Multiple-degree-of-freedom systems: Free vibration, forced response, damping models, response properties. Random vibration.
Vibration measurement: Transducers, conditioning, recording, display and analysis instruments. Digital analysis techniques: Frequency analysis, Digital signal processing.
Applications: Vibration monitoring and artificial intelligence in monitoring, Human vibration, Experimental modal analysis, Operational deflection analysis, Model updating and modification.
Prerequisite: A working knowledge of MATLAB.

13. TIMETABLE

It is expected that the student will come prepared to the first block. All students who did not receive a study guide, at least 2 weeks before commencement of course, should immediately contact the relevant lecturer.

FIRST SEMESTER

MODULE	CODE	CONTACT PERSON	VENUE/TIME	DATE
Finite Element Methods	MEE 732	Mr N Wilke 012 420 2861 nico.wilke@up.ac.za	Eng I, 1-12 08:30	25-26 January 1-2 March 12-13 May Exam – 4 June
Vibration	MEV 732	Prof PS Heyns 012 420 2432 stephan.heyns@up.ac.za	Eng I, 1-12 08:30	28-29 January 18-19 March 6-7 May Exam – 15 July
Advanced Fluid Mechanics	MGM 732	Mr JJ Vadasz 012 420 4743 Johnathan.vadasz@up.ac.za	Eng I, 1-12 08:30	1-2 February 15-16 March 19-20 April Exam – 1 June
Advanced Vehicle Engineering	MGV 732	Prof PS Els 012 420 2045 schalk.els@up.ac.za	Eng I, 1-12 08:30	8-9 February 29-30 March 10-11 May Exam – 2 June
Maintenance Practice	MIP 732	Mr H Ellis 083 267 5331 Hermane888@gmail.com	Eng I, 9-7 Postgraduate Centre L2-71 Postgraduate Centre L1-56 08:30	4-5 March 29-30 March 10-11 May Exam – 14 July
Design	MOX 732	Prof NDL Burger 012 420 3764 danie.burger@up.ac.za	Eng I, 1-12 08:30	4-5 February 25-26 March 3-4 May Exam – 8 June
Thermoflow	MTV 732	Dr T Bello-Ochende 012 420 3105 tunde.bello-ochende@up.ac.za	Eng I, 1-12 08:30	15-16 February 22-23 April 24-25 May Exam – 13 July

SECOND SEMESTER

MODULE	CODE	CONTACT PERSON	VENUE/TIME	DATE
Advanced Heat and Mass Transfer	MHM 732	Prof JP Meyer 012 420 2590 josua.meyer@up.ac.za	Eng I, 1-9 13:30-15:20	Every Friday from 30 July – 29 October* Exam – 1 November
Condition Based Maintenance	MIC 732	Mr C van der Walt 012 991 0478 christo@edprevent.com	Except 16-17 Aug**: Eng I, 1-12 08:30	16–17 August 16–17 September 4–5 October Exam 5 Nov
Reliability Engineering	MIR 732	Mr E Bradley 011 465 0275 edgar.bradley@telkomsa.net	Eng I, 10-24 08:30	29-30 July 26-27 August 7-8 October Exam - 8 November
Tribology	MIT 732	Prof NDL Burger 012 420 3764 Danie.burger@up.ac.za	Eng I, 1-12 08:30	2-3 August 6-7 September 11-12 October Exam – 15 November
Structural Integrity	MSI 732	Dr HM Inglis 012 420 3125 Helen.inglis@up.ac.za	Eng I, 1-12 08:30	5-6 August 9-10 September 18-19 October Exam – 16 November
Numerical Thermoflow	MSM 732	Dr T Bello-Ochende 012 420 3105 tunde.bello-ochende@up.ac.za	Eng I, 1-12 08:30	29-30 July 2-3 September 14-15 October Exam – 12 November
Structural Mechanics	MSY 732	Mr S Bugarin 012 420 3695 sinisa.bugarin@up.ac.za	Eng I, 1-12 08:30	12-13 August 13-14 September 21-22 October Exam – 19 November

* Where the Friday periods will cause a clash with the block presentation of other selected modules, students should kindly notify Prof Meyer, so that the clash can be resolved.

** MIC 732 16 & 17 August 2010 venue: Mathematics Building, Small Boardroom (building closes at 16:00)

APPENDIX 1: ARRANGEMENTS FOR DISSERTATIONS AND THESES

The procedure in this appendix does not replace any official regulations and/or requirements and are simply intended as an aid to students. The responsibility however still rests with students to familiarise themselves with the official regulations and procedures.

A1.1. Confidentiality of dissertations and theses

It is the policy of the faculty that dissertations and theses may not be confidential or classified. Deviation from this rule will only be considered under very exceptional circumstances by the Postgraduate Committee of the Faculty on the recommendation of the Head of Department. Where a student wishes to submit a classified dissertation or thesis, the Postgraduate Committee of the Faculty must grant approval before the student registers for study. In such a case the student must still submit an article for publication.

A1.2. Registration of titles

The proposed title of a student's dissertation/thesis must be approved by the supervisor and co-supervisor, if applicable, and the Departmental Management Committee. In order to do this MEng, MSc and PhD students in collaboration with their supervisors must fill out a title registration form. An electronic version of this form is available and must be used - www.me.up.ac.za - Lecturer's Notice board. The Faculty form with the title “Proposals with regard to titles of theses/dissertations, supervisors and external examiners”, also available on the Lecturer’s Notice board, must be used by the supervisor to suggest possible external examiners. The student is not permitted to see the copy of this form once the supervisor's recommendation with regards to external examiners has been completed. The final appointment of external examiners is administered by the Postgraduate Committee of the Faculty.

A1.3. Submission of dissertations/theses

The student must inform Ms S Steenberg, Student Administration at least two months before submission of a dissertation/thesis of his/her intention to submit examination copies.

Examination copies must be submitted to Ms S Steenberg, Student Administration.

All other information pertaining to master's and doctoral studies is available in the year book, *Faculty of Engineering, Built Environment and Information Technology: Part 1: School of Engineering*. This is available for download as a pdf document at this link, or at http://web.up.ac.za/ > New Students > Yearbooks.

APPENDIX 2: PUBLICATION POLICY

It is important to advance research in the department and to ensure that the department remains active in research. In doing so the necessary infrastructure is created in which students may receive high quality education.

A2.1. Arrangements pertaining to masters and doctoral students

Because exposure to the free literature creates an atmosphere in which work of high quality can prosper, the department considers it important, and therefore the following arrangements are applicable to masters and doctoral research:

- All candidates for the masters degree must submit at least one article for publication in an ISI journal. This article must be based on research done for the dissertation, and must be approved by the supervisor. The degree will not be conferred before proof of receipt by the journal is submitted to the Student Administration.

- All candidates for the doctoral degree must submit at least two articles for publication in an ISI journal, before submission of the thesis. This article need not cover the whole field of the thesis or even the largest part thereof, but research for this specific part must be done in collaboration with the department. The degree will not be conferred before proof of receipt by the journal is submitted to the Student Administration.

A2.2. Arrangements with respect to authorship of publications

The name of the supervisor(s) must appear as co-author(s) on the publication unless the supervisor decides differently. To show that the work has been done in the department, the address of the authors must be indicated as the address of the department.

In determining the authorship of publications forthcoming from studies, the following guidelines will be followed:

- If the supervisor initiated the specific study project, i.e. identified the necessity and potential thereof and created the basic infrastructure and followed the development of the work on a regular basis, he/she must be an author and usually for the first publication forthcoming from the work, the main author.

- If the student initiated the project or certain aspects thereof and helped with the writing of the paper on his original input, he becomes the main author, while the supervisor becomes the co-author.

- If, after the student has completed his/her study, he/she is not interested in publishing certain publishable aspects of the work in collaboration with the supervisor, the university retains the right to publish this work. If the publication and its logic come directly from the report, the student will be approached as co-author, while the supervisor who writes the article will be the main author.

- Sometimes there are cases, which will not clearly fall in any of the above categories. Here the case will be decided at the hand of the following questions (in priority order):

  Who initiated the project?
  Whose idea was the publication?
  Who thought out the logic of the publication?
  Who wrote the publication?
  Who did the project work?

Students are reminded that dissertations and theses are university documents, and where any publication is extracted from such documents (irrespective of where the research was done and who the author is) the publication must be approved by the department.

REGISTER OF MODIFICATIONS TO THIS DOCUMENT

Revision Number	Publication date	Changes
0 (Original)	30 October 2009	
1	2 December 2009	• Exam date for MEV 732 Vibration changed • Dates of 2nd pair of block days of MIP 732 Maintenance Practice changed • Venue and more precise dates and times for MHM 732 Advanced Heat and Mass Transfer announced. • Module content of MGV 732 updated • Information on supplementary examinations added.
2	19 January 2010	• Links to year book updated to 2010 version • Module MNO 732 Numerical Techniques and Optimisation, no longer being offered, removed.
3	5 August 2010	• Some details updated in first semester time table. • Modified dates for MHM 732 Advanced Heat and Mass Transfer announced. • Modified dates and lecturer contact information for MIR 732 Reliability Engineering supplied • Modified dates and lecturer contact information for MIC 732 Condition Based Maintenance supplied. • Modified lecturer contact information for MSM 732 Numerical Thermoflow