



School of Science and Engineering

DEPARTMENT OF ENGINEERING

ENMP407-10B

Special Topic in Materials and Process Engineering – Best Practice Operation of Industrial Compressed Air Systems

Paper Outline : 2010

Last update: 24-3-2010

LECTURERS:

Dr James Neale (Course Co-ordinator)

Room F.2.08

Phone 07 858 5179

Dr Michael Walmsley

Room EF.2.02

Phone 07 838 4701

DESCRIPTION:

This course provides an introduction to industrial compressed air systems (CAS) and the best practice standards to which they should be operated. The course material is aligned with the CAS best practice programme co-ordinated by the Electricity Commission and is a prerequisite to becoming an accredited auditor under this programme. The course will also have application to plant and maintenance engineers and graduate engineers with an interest in industrial energy efficiency. Topics include compressed gas theory, compressor technologies and efficiency measures, auxiliary equipment, distribution and end use of compressed air, CAS auditing methodologies; including metering and data acquisition standards, data analysis and report preparation. The identification of energy efficiency opportunities and cost benefit estimation will also be discussed. A significant portion of the course will be spent on practical laboratory assignments including data acquisition, analysis and interpretation and general energy efficiency opportunity identification.

LEARNING OUTCOMES:

Students who successfully complete this paper should be able to:

- Differentiate between best practice and sub optimal CAS installations and identify the appropriate energy savings measures to be implemented.
- Recognise common CAS hardware in real-world engineering situations and be able to identify if it is performing correctly and if the appropriate technology is being employed.
- Understand the operation and control of a multiple compressor CAS installation and how to determine if it is running efficiently.
- Conduct an initial walk through CAS assessment consistent with the EC CAS best practice guidelines.
- Plan and execute an in-depth audit of a CAS in line with the EC CAS best practice guidelines.
- Recognise options for CAS leak management, minimisation and/or elimination of artificial system demand and the identification of peak demand loads and how these can be managed efficiently.
- Analyse CAS performance data to identify current and potential performance benchmarks and estimate the potential cost saving opportunity.
- Apply process synthesis skills to aid design activities as a practicing engineer.

COURSE DATES:

Enrolment Deadline: Friday 9th July, after which late enrolment fees may apply.

Day 1: Monday 23rd August

Day 2: Tuesday 24th August

Day 3: Wednesday 25th August

Lectures	F2.11
Tutorials	F2.11

Final test: Electronically delivered on Monday 1st November

LABORATORY WORK:

There are three laboratory exercises involving (1) compressor efficiency measurements, (2) CAS leak and artificial demand assessments and (3) CAS metering. There will also be a series of site visits to view a range of CAS installations of varying scales. These labs will be held on each afternoon of the three days on the university campus from 2 to 5 pm. There will be a written assignment associated with the site visit.

ASSIGNMENTS:

There will be one assignments with both multiple choice and short answer questions aligned with the two on campus teaching blocks, and two corresponding short essays (discussion topics). Information covering submission procedures (electronic and postal) will be provided following enrolment.

TEXTBOOKS/REFERENCE BOOKS:

Reading material and course information will be available for electronic download through the University of Waikato Website following confirmation of enrolment.

ASSESSMENT:

The course work/final test ratio is 60:40.

Course work will comprise:

2 Essays	20% (10% each)
1 Assignments	10%
2 Laboratory Reports	20%
1 Presentations	5 %
1 Industrial CAS Assessment	5 %

The presentation will need to be made during the on campus work period (23-25th August), with prior approval of the topic required. All internal assessment work will need to be submitted no later than 4th October to allow sufficient time to provide feedback to students prior to the final test/exam.

FINAL TEST:

There will be a **final** test (exam) which counts for 40 % of the overall course grade; consisting of 10 multiple choice questions, short answer questions, 1 essay question and 1 data analysis question. This will be an open book, with the use of a computer allowed for the data analysis section; however the essay will need to be hand written. The format of the final test will be discussed in lectures during the last day of the course. A practice exam will be provided at the conclusion of the lecture/tutorial block.

PROCEDURES:**Extensions/Late Work**

Students must complete a "Special Consideration" form, available from the Engineering Department secretary, in E.G.04.

The form must be completed and co-signed by the lecturer involved *prior to the deadline for handing in work*. Late work generally penalised at 5% per working day. We will do everything we can to be as flexible as possible but this will also require your co-operation.

Laboratory work and assignment work is compulsory and must be submitted to pass this course.

ADDITIONAL INFORMATION:

For information relating to the following: Monitoring and review, links between teaching and research, health and safety, class representation, complaints procedures, code of conduct and plagiarism, please refer to the School's website at: <http://www.sci.waikato.ac.nz/outlines.shtml>. Students should ensure they familiarise themselves with the information in this course outline and the associated web pages.

In the event of unforeseen circumstances, the actual dates given in the timetable may be subject to changes.

Your attention is drawn to the following regulations and policies which are published in the University Calendar:

- *Assessment Regulations*
- *Discipline Regulations*
- *Computer System Regulations*
- *Policy on the Use of Māori for Assessment*
- *Human Research Ethics Regulations*
- *Student Research Regulations*

IMPORTANT NOTE FOR INTERNATIONAL STUDENTS:

For international students in New Zealand under student visas, regular attendance is part of your visa obligation and is checked as a requirement of the University under the Code of Practice for the Pastoral Care of International Students, to which the University is a signatory. Staff are formally required to monitor attendance and submission of compulsory assessment items and to report to the International Centre if there are problems that cannot be resolved.

Enrolment Process:

There are two routes to enrolling in the course. You choose one.

If you do not hold a University degree or equivalent you will probably enrol through the Waikato Pathways College in the paper with code **CEST73-09C(HMN)** and title **Materials and Process Engineering Elective**. To do this you need to email Anna Pinder, School Registrar, School of Science & Engineering, (a.pinder@waikato.ac.nz) who will pass your expression of interest on to the Pathways College. They in turn will send you an application form and instructions as to how to proceed with your enrolment. This is a very simple process and does not require the presentation of any additional documentation. The course does not contribute to any University Qualification however. If you would rather gain credit towards a University of Waikato Qualification please email Anna Pinder, Associate Dean Science & Engineering (t.cartner@waikato.ac.nz) and ask about options. Fee: \$1995 plus gst and any applicable application fees.

If you hold a University Qualification or equivalent then you should apply to enrol in the qualification of **Graduate Diploma in Materials and Process Engineering** (GradDipMAPE) and into the 2009 paper with code **ENMP407-08B(HAM)** and title **Materials and Process Engineering Elective**. This can be done on-line by following the instructions below. If you would prefer to fill out an enrolment form you can do this by emailing Anna Pinder, School Registrar, School of Science & Engineering (a.pinder@waikato.ac.nz) requesting an application form. To enrol in the University paper there are some documents you will need to provide before you can be enrolled. These are things like a verified copy of birth certificate or passport. A checklist is provided in the application form. Fee: \$443 plus gst and any applicable application fees.

You need to provide an **admission to university** reason. If over 20 you can apply by **special admission**. If under 20 you will need to apply either by already having **university entrance** or by **discretionary entrance**(in either case you will need to provide details of previous educational achievement).

Online enrolment instructions

If you have not yet started the online application, please go to <http://www.waikato.ac.nz/> and select 'Apply to Enrol', then 'Apply Now'. Once you have correctly answered the pre-application questions and have received your student ID number by email, please make sure the year you wish to enrol in is correct and click on 'Apply to Enrol' and follow the directions to add Graduate Diploma Materials and Process Engineering as qualification and ENMP407-09B(HAM) as paper.

To add 2009 paper you wish to study, please go back into the application you created under student ID number **???????**. If you have already started the an online application and the qualification you would like to study is listed, click on 'View', if you would like to change your qualification, click on 'Change'. To add the paper you wish to study, please click on 'Add Papers'. ENMP407-09B (HAM) is the code of the paper, enter these details into the boxes next to 'Code' and click on the 'Search' option Tick the box next to paper and then click on 'Add Selected Papers'. This will apply the paper you selected to your application.

If you would like to view the details and timetable entries of the papers we offer at the University of Waikato, please go to the following University website <http://papers.waikato.ac.nz/>.

Please complete all compulsory sections which contain a red star (*) and click on the 'submit application' button on the final screen. This will submit a formal application to study and we will be in contact with you shortly.

If you have any further queries or concerns, please email Anna Pinder, School Registrar, School of Science & Engineering (a.pinder@waikato.ac.nz) or Phone 07 838 4290.

ENMP407-09A Lecture Timetable

Date		Lect & Tuts	Lecture Material	Reading	Assignments	Labs
Day 1 23 rd Aug	8 am	L1	Introduction – Thermodynamics of compressed gases			
	9 am	L2	Pipe Flow dynamics and compressible flows			
	10 am	L3	Compressor Technologies			
	11 am	L4	Compressor Operation and Control			
	1 pm	T1	Compressed Gas Dynamics and Essay Discussion Topics			
	2-5pm	Lab1	Compressor Efficiency Measurements			
	7-8:30pm		Student Presentations			
Day 2 24 th Aug	8 am	L5	Environmental Conditions and Effects			
	9 am	L6	Auxiliary CAS Equipment			
	10 am	L7	CAS Demand Reduction (Leaks, Artificial Demand, Peak Load Management)			
	11 am	L8	Metering Technology			
	1 pm	T2	EC CAS Audit Guidelines			
	2-5pm	Site Visits	CAS Installations and Measurements			
	7-8:30pm		Student Presentations			
Day 3 25 th Aug	8 am	L9	Data Analysis Methods and Report Writing			
	9 am	L10				
	10 am	L11	Error Analysis and Risk Assessment			
	11 am	L12	Opportunity Identification and Assessment			
	1 pm	T3	CAS Calculations and Assessments			
	2pm	Lab2	Leak Management and Artificial Demand			
Final Test 1st Nov			Test			