MODULE DESCRIPTION FORM

DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

ME507 MACHINERY DAIGNOSIS AND CONDITION MONITORING

Module Registrar: Dr Olga Ganilova olga.ganilova@strath.ac.uk	**Taught To (Course): Cohorts for whom class is optional / elective**	
Other Lecturers Involved: Dr Graeme West	**Credit Weighting: 10 (ECTS 5)**	**Semester: 2**
Optional / elective class	**Academic Level: 5**	**Suitable for Exchange: Y**

Required prerequisites

Note: It is the responsibility of ALL students to ensure that they satisfy the prerequisite knowledge for this module BEFORE adding as part of curriculum selection. If unsure, please contact the Module Registrar or discuss with your Programme/Year Adviser of Studies.

Knowledge of fundamentals of vibration:
- single degree of freedom systems;
- equations of motion for free and forced vibration;
- effects of damping;
- modes of vibration;
- methods of identification of period, frequency, phase and amplitude of vibration.

Knowledge of signal processing basics:
- Filtering;
- Fourier transformation;
- Difference between time domain and frequency domain data representation.

Module Format and Delivery (HOURS i.e. 1 credit = 10hrs of study):

Lecture	Tutorial	Laboratory	Groupwork	External	Online	Project	Assignments	Private Study	**Total**
16	14		15		10			45	100

Educational Aim

Condition monitoring and fault detection in machinery plays an important part in the maintenance and protection of equipment, and has come to the fore since the recent advances in computer-based systems. The aim of the class is therefore to provide an understanding of Condition Monitoring (CM) and its relevance to industry. This is achieved by studying the fundamentals of CM and Vibrational CM, integrity assessment techniques, the instrumentation and their utilization, and how they are applied. Particular attention is paid to vibration-based health monitoring as well analysis of faults and their detection.

Learning Outcomes

On completion of the module the student is expected to be able to:

LO1 Have an appreciation of fundamentals of condition monitoring approaches, methods, and techniques.

LO2 Understand and be able to apply main techniques and methods of vibration-based CM.

LO3 Have an awareness of intelligent condition monitoring and be able to understand and apply rule-based and cased-based reasoning approaches.

LO4 Have an appreciation of some basic faults in machinery, their manifestation, and methods for detection and recognition.

Syllabus

The module will teach the following:

The basic idea and fundamentals of CM of machines. This will include application, advantages, and alternatives as well as fundamental techniques of CM. Detailed consideration of Vibrational CM and its applications, including measurements, typical signals and data processing, application of sensors and transducers. An introduction to intelligent condition monitoring, knowledge engineering and case study applications of rule- and case-based reasoning approaches. Different types of faults and techniques of their detection will be introduced and discussed in detail. Intelligent CM and its industrial applications. Machine learning application in predictive maintenance, data collection, processing, and security.

Assessment of Learning Outcomes

Criteria

For each of the Module Learning Outcomes the following criteria will be used to make judgements on student learning:

LO1
C1. The ability to explain the main maintenance strategies and suggest relevant ones for simple equipment.
C2. Ability to recognise the main monitoring strategies and explain their main applications for simple equipment.
C3. Ability to analyse random and harmonic signals, determine their main characteristics and be able to predict their behaviour.

LO2
C1. The ability to analyse the dynamics and vibration of simple systems and machinery in terms of characteristics of vibrational behaviour.

LO3
C1. The ability to apply rule- and case-based reasoning approaches to example problems in the context of rotating machinery diagnosis.
C2. The ability to describe the process of designing an expert system for decision support, including the role of knowledge engineering in extracting and codifying human expertise.

LO4
C1. Ability to distinguish between different machinery faults in terms of the frequency range where they can be first detected.
C2. Be aware and be able to estimate the characteristic frequencies and the parameters through which some basic machinery faults can be detected and estimated.

The standards set for each criterion per Module Learning Outcome to achieve a pass grade are indicated on the assessment sheet for all assessment.

Principles of Assessment and Feedback
(within Assessment and Feedback Policy at: https://www.strath.ac.uk/professionalservices/staff/policies/academic/)

Assessment is performed as:

- a 2-part coursework based on the group work on a case study allocated with an individual submission made online.
- Interim presentation to demonstrate the progress on the coursework and receive technical feedback.

Feedback is given in different forms:

- Immediate self-directed feedback through in-class discussions and questions
- Online written feedback from the Case Study coursework through Myplace
- Informal feedback will be provided at regular tutorial sessions primarily through verbal discussion with individuals or groups.
- Online feedback from the Online Assessment through Myplace
- Individual feedback will be provided by request through email

Assessment Method(s) Including Percentage Breakdown and Duration of Exams *(individual weightings)*

Presentation		Coursework	
Number	***Weighting***	Number	***Weighting***
1	20%	1	80%
*LO1		**LO1, LO2, LO3, LO4	

* ***L/Os:*** *Indicate which Learning Outcomes (L01, L02, etc) are to be assessed by exam/coursework/practical/project as required.*

Coursework / Submissions deadlines (*academic weeks*):

Presentations will be delivered in week 7.
The coursework should be submitted during week 11.

Resit Assessment Procedures:
Resubmission of an alternative^^coursework(s) prior to commencement of the August exam diet.

^^Students must contact the module Registrar for details as soon as results confirm that a resit is required.

PLEASE NOTE:
Students must gain a summative mark of 50% to pass the module. Students who fail the module at the first attempt will be re-assessed before the August diet. This re-assessment will consist entirely of coursework. No marks from any previous attempts will be transferred to a new resit attempt.

Recommended Reading

*****Purchase recommended **Highly recommended reading *For reference (do NOT purchase)**

**H. Ahmed, A.K. Nandi, Condition monitoring with vibration signal. Compressive sampling and learning algorithms for rotating machines.
**P.Girdhar, C. Scheffer, Practical machinery vibration analysis and predictive maintenance
**M.Adams, Rotating machinery analysis - from analysis to troubleshooting

Additional Student Feedback
(Please specify details of when additional feedback will be provided)

There will be an additional feedback session if required

Date	Time	Room No
April 2023 (exact date TBC)	TBC	TBC

Session: 2023-24

Approved:

Course Director Signature:	**S Connolly (on behalf of E Henderson)**
Date of Last Modifications:	**24/08/2023**

(Updated August 2023)

MODULE TIMETABLE

Module Code:	**ME507**	**Module Title:**	**Machinery Diagnosis and Condition Monitoring**

Brief Description of Assessment:

The 2-part coursework is based on group work on a case study with an individual submission made online in week 11 (worth 80%).
Interim presentation is to be delivered in week 7 to demonstrated the progress and initial outputs of work on Part 1 of the coursework (worth 20%).

Assessment Timing:-

Please note: Timings can and will change, this should only be used as a guide.

Semester One	W&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item.

Semester Two	C&D Wk	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	WK10	WK11	Exam Period
	Choose an item. Choose an item.	Choose an item. Choose an item.	Course work Set (Part 1)	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Choose an item. Choose an item.	Present ation Choose an item.	Choose an item. Choose an item.	Course work Set (Part 2)	Choose an item. Choose an item.	Course work Submit	Choose an item.