THE UNIVERSITY OF WESTERN AUSTRALIA

Unit Outline
School of Mechanical Engineering

Mechatronics Design
MCTX3420

6 pts

Semester 2

CRAWLEY Campus

Unit Coordinator: Adrian Keating

Unit web site:
http://www.mech.uwa.edu.au/mechatronics/MD/

Document version :3420/Crawley/AK/05.08.09.

Contents

UNIT DESCRIPTION

Introduction

The unit is taught by Dr. Adrian Keating. The unit aims to develop knowledge and experience with mechatronics systems, specifically the design aspect of those systems. This is accomplished through:
Lectures which present detailed material which walks through a typical mechatronic system
Tutorials which are performed as demonstrations to students of key concepts presented in the weeks lectures.
Laboratories which expose students to real mechatronics sensors and actuators, requiring them to read data sheets and design systems.
Projects which develop teamwork skill and require detail design of a system and it's sub-system components.

Unit content

This unit covers (1) functional block diagrams, specification methods, specifying information transfer and interfaces; (2) review of simple actuators, electric motor, hydraulic and pneumatic systems; (3) communicating signals in mechatronic systems, interface technologies and signal conditioning; (4) noise, electromagnetic interference and compatibility in mechatronic systems; (5) data acquisition fundamentals; (6) sensor technologies, construction and testing of analogue sensing device and pre-amplifier; (7) importance of standards; (8) heat management in systems; (9) project work in teams on mechatronic systems and devices using laboratory hardware; (10) formal techniques for project planning, documentation, team development and performance monitoring; and (11) mechatronic engineering practice—site visit.

Learning outcomes

On completion of this unit, you should be able to:

- Apply the scientific fundamentals of mechatronics systems;
- learn communication skills for close co-operation with technical peers;
- obtain in-depth knowledge of mechatronic engineering component characteristics through project work;
- able to solve implementation problems for mechatronic systems and components through project work and assignments;
- develop a systems approach through the use of functional block diagrams;
- learn team skills through formal instruction and project work;
- and develop independent self-directed study and group learning skills.

Educational Principles

In this unit, you will be encouraged and provided the opportunity to develop the ability to design Mechatronic Systems through proper scheduling and planning of work, allocation of resources and methodical engineering approach to problem solving.

CONTACT DETAILS

Unit contact	Adrian Keating
Unit coordinator	
name:	Adrian Keating
email:	keating@mech.uwa.edu.au
phone:	6488 3098
fax:	6488 1024
consultation hours:	TBD
lecture times:	Monday 10am
lecture building & room:	Maths, Blakers
Lecturer	
name:	Adrian Keating
email:	keating@mech.uwa.edu.au
phone:	6488 3098
fax:	6488 1024
consultation hours:	
lecture times:	Monday 10am
lecture building & room:	Maths, Blakers
Tutor(s)	
name:	As above
email:	As above
phone:	As above
fax:	As above
consultation hours:	As above
tutorial times:	Friday 9-11, 11-1
tutorial building & room:	ENCM:113

TEACHING AND LEARNING RESPONSIBILITIES

Teaching and learning strategies

Key to learning about mechatronic Design is to practice it. This unit does this through Laboratories and Projects. The Labs/Project leverages students previous knowledge and Lectures and Tutorials provide additional supporting knowledge, designed to be incorporated into Labs and Projects. Students should seek at all times to explore and develop their understanding of Lecture and tutorial knowledge through their Laboratory assignments and Projects.

Tutorials will be used to demonstrate key concepts form the Lectures. Where possible tutorials will be mini-hands on labs. In most instances, within the tutorial, multimeters and an oscilloscope will be used at measure and analyse a variety of components typical of mechatronic systems including (but not limited to) fuses, sensors, actuators and noise. Students will have the opportunity to see real time measurements, ask questions and subsequently use real data to answer in –tutorial or take-home tutorial questions which will be graded.

Laboratories use commercially available kits and require students to read, understand and use the information in datasheets to design and build sensors and actuators. These Laboratories are run in teams of 2 MCTX3420 students. Detailed instructions required to start thes Labs are available on the Mechatronics Design Website. Labs are self directed by the team, and are not run by a tutor or Lab demonstrator. Don't wait for direction to start - Just start. Dr. Keating is available during office hours, during tutorials and upon request (with 24 hours notice) to meet and assist teams where problems are encountered. Labs are conducted using kits which are available from

Projects are team based and require students to consider the overall elements of a mechatronics system. However, as mechatronics systems are large and complex, the system must be broken into smaller, manageable sub-systems. Each team member will be responsible for a sub-system element. Teams consist of both MCTX3420 and MCTX2420 students. MCTX3420 Mechatronics design students are expected to take on a greater responsibilities within the team, such as guiding and advising the MCTX2420 students and demonstrating elements of design within their systems and sub-system elements. Supervisors act as clients in this team-supervisor relationship. They may also provide guideance and equipment support where required. Unit-co-ordinators for MCTX3420 and MCTX2420 are available during office hours and upon request (with 24 hours notice) to meet and assist teams where problems are encountered, including but not limited to conflict resolution. A list of current and pass projects are maintained on the Mechatronics Wiki page.

Charter of student rights

This Charter of Student Rights upholds the fundamental rights of students who undertake their education at the University of Western Australia.

It recognises that excellence in teaching and learning requires students to be active participants in their educational experience. It upholds the ethos that in addition to the University's role of awarding formal academic qualifications to students, the University must strive to instil in all students independent scholarly learning, critical judgement, academic integrity and ethical sensitivity.

Please refer to the guild website the full charter of student rights, located at http://www.guild.uwa.edu.au/info/student_help/student_rights/charter.shtml.

Student Guild contact details

The University of Western Australia Student Guild
35 Stirling Highway
Crawley WA 6009
Phone: (+61 8) 6488 2295
Facsimile: (+61 8) 6488 1041
E-mail: enquiries@guild.uwa.edu.au
Website: http://www.guild.uwa.edu.au

Use of student feedback

Spots and SURF reports are used towards the end of semester to obtain student feedback.

Students are also asked for a confidential report describing their experience in this unit and thoughts on improvements to the unit.

In addition, students are regularly informally asked during project, laboratory and tutorial hours for feedback relating to aspects of the unit.

From student comments in 2008 the following changes were made to the unit:

- A detailed set of bound Mechatronics notes was created last year. These have be revised and improved.
- We have several new projects in interdisciplinary fields - Physics, Biochem, Dept of Agriculture (as well as EECE and Mech)
- Project assessment has been reviewed (along with MCTX2420) with the aim of reducing the load on students.
- Laboratory exercises have been improved. Lab instructions have been improved. Lab weighting has been made more appropriate to effort. A new Lab 1 has been created based on commercial kits :Sensor + Relay (more mechatronics)
- Effort has been made to connect diverse topics covered in lectures. Lecture material is consistent with material covered in tutorials.
- Tutorial assessment has been expanded to include in-class quizzes to reduce out of class work load.
- More work on standards has been worked into the notes
- Site visits have been included based on student feedback

ASSESSMENT MECHANISM

Assessment mechanism summary

Item	Weight	Due date
Tutorial exercises/activities	20%	In tutorial or by the Thursday before next tutorial
Lab 1	8	Thursday 5pm Week4
Lab 2	17	Thursday 5pm Week9
Project – fortnightly reports	10	Fortnightly, by Thursday 5pm
Project – Scoping Document	15	Thursday 5pm Week5
Project – Final report	15	Thursday 5pm Week13
Project – Individual (Confidential) report	5	Thursday 5pm Week13
Project - Presentation	5	During Week12
Contribution/Site Visit	5	1- week after site visit

Unit marks may be **scaled** in line with the Faculty's Policy on Assessment Practices and Procedures: www.ecm.uwa.edu.au/studentnet/exams/assessment

Assessment details

Tutorial exercises/activities

Description and guidelines: Tutorials questions are set and are answered either within the tutorial or within 1-week of the tutorial. This varies week to week, based on other deliverable in this unit. Assessments will look for students comprehension of the lecture and tutorial material

Grading: based on 0-4 criteria.

0 = no submission, 1- below standard, 2- needs improvement, 3- good, 4- excellent

Submission: Individual submission, to MCTX3420 assignment Box. For out of class assignment, submit by 5 pm Thursday the week after the tutorial. All submissions must include a signed coversheet.

Lab 1 & Lab 2

Description and guidelines: Lab write up/assignments must show application of mechatronics concepts and Mechatronics Design such as those presented in the Lecture material and tutorials.

Grading: A pass can be obtained for non functioning laboratory circuits so long as sufficient effort and reasonable clear thinking can be demonstrated regarding testing and debugging of the circuits, exploring all possible reasons for the non-functioning operation. High marks are awarded for quality measurements, insightful analysis and novel application of the circuits.

submission: Team submission with individual effort identified (see Laboratory notes). Submit to MCTX3420 assignment Box by 5 pm Thursday the week due. All submissions must include a signed coversheet.

Project – Fortnightly reports

Description and guidelines: These reports must clearly indicate the work done in the past 2 weeks and the work proposed to be done in the next 2 weeks. Students are asked to provide a score for each member of the team based on effort and performance.

Grading: Students must demonstrate consistent effort and adherence to the work promised to be done. Reasoning must be given for all decision and directions taken. Students score for each member are taken into consideration when assigning the grade. Fortnightly grade is based on 0-8 criteria.

0 = no submission, 2- below standard, 4- needs improvement, 6- good, 8- excellent

Submission: Individual submission. Submit to Mechatronics Project assignment Box by 5 pm Thursday of the week due. All submissions must include a signed coversheet.

Project – Scoping Document

Description and guidelines: These reports must summarise the project and the proposed scope of the work for each student. The report must show application of mechatronics concepts and Mechatronics Design such as those presented in the Lecture material and tutorials. Sub-systems for each team member must be described in detail, and must include function block diagrams or flow-charts where appropriate.

Grading: Students must demonstrate clear thinking and solid design reasoning for the direction of the work proposed. Illogical or unsupported comments will score poorly. Student must demonstrate the body of work proposed to be done is sufficient for the time required (~8 hours per week for 13 weeks).

Submission: Team submission with individual effort identified (see Scoping documentation notes). Submit to Mechatronics Project assignment Box by 5 pm Thursday of the week due. All submissions must include a signed coversheet.

Project – Final report

Description and guidelines: This reports must summarise the project and detail the effort of each student. The report must show application of mechatronics concepts and Mechatronics Design such as those presented in the Lecture material and tutorials. Sub-systems for each team member must be described in detail, and must include function block diagrams or flow-charts where appropriate.

Grading: Students must demonstrate clear thinking and solid design reasoning for the direction of the work proposed. Illogical or unsupported comments will score poorly. Student must demonstrate the body of work presented was sufficient for the time expected to have been spent (~8 hours per week for 13 weeks).

Submission: Team submission with individual effort identified (see Final Report documentation notes). Submit to Mechatronics Project assignment Box by 5 pm Thursday of the week due. All submissions must include a signed coversheet.

Project – Individual (Confidential) report

Description and guidelines: This is a report on your contributions to the project, the time you spent, your experience, and what you learned from the project (4 pages maximum). Please backup you comments with details and examples. You are also encouraged to include your suggestions for improving the course in this report.

Grading: Grade is based on how much critical thought and insight has been put into the comments.

Submission: This must be submitted separately by each individual group member to the relevant assignment box (either MCTX3420 or MCTX2420). Submit to the relevant assignment Box by 5 pm Thursday of the week due.

Project – Presentation

Description and guidelines: This is a verbal presentation to summarize and showcase the work you have performed within the project. Working models, mockups and code should be demonstrated at this time.

Grading: At least two reviewers will be used to evaluate the group presentation. The grade will be determined based on the group as a whole and the performance of each student. Therefore, this grade will be unique for each student. Students are expected to be able to answer detailed questions on their own part in the project and general questions on the work of their colleagues in the team.
Submission: During the lead up to Week12, A timetable will be on display in the Mechatronics Lab (G.19) showing the time-slots available for demonstrations of each project (will depend on supervisors' teaching and other fixed commitments). The students should reserve time-slots. Grading will be done during the presentation.

Project – Site-Visits

Description and guidelines: On the request of students, site visits have been arranged for this year. A limited number of no more that 15 students will be permitted in each site visit. A signup sheet will be provided to students to select a preferred site visit date. These will be held (most like on Thursdays afternoon in September). These are graded site visits. If students cannot attend a site visit they must arrange there own visit with an engineering site after approval of the visit from the unit co-ordinator.

Grading: Students will be expected to summarise the site visit in less than 2 pages, detailing observations of mechatronic systems observed and comments from the person leading the visit. Students are encouraged to draw from the Lecture material to explain the operation of specific equipment at the site visited. Function block diagrams of equipment observed are encouraged.
Submission: This reports are individual submissions to the MCTX3420 assignment box by 5 pm Thursday , 1 week after the site visit.

Late Submission Penalties

Fortnightly reports and tutorial assignment submitted late will be read but no marks will be awarded.

Late submissions of scoping document, final project reports, confidential report and Laboratory assignments will be penalised: the marks will be reduced by 25% of the granted mark per week past due date.

Special Consideration

The university policy on special consideration has changed. Applications for consideration, deferral of tests or exams or extensions of time for assignments on medical, personal or other grounds must be lodged with the faculty office no later than three working days after the due date for the assessment in question. This rule will apply to all students, except in exceptional circumstances ('exceptional' does mean 'exceptional', not 'just didn't have time to get around to it').

Ethical Scholarship, Academic Literacy and Academic Misconduct

[Ethical scholarship is the pursuit of scholarly enquiry marked by honesty and integrity.
Academic Literacy is the capacity to undertake study and research, and to communicate findings and knowledge, in a manner appropriate to the particular disciplinary conventions and scholarly standards expected at university level.
Academic misconduct is any activity or practice engaged in by a student that breaches explicit guidelines relating to the production of work for assessment, in a manner that compromises or defeats the purpose of that assessment. **Students must not engage in academic misconduct**. Any such activity undermines an ethos of ethical scholarship. Academic misconduct includes, but is not limited to cheating, or attempting to cheat, through:

- Collusion
- Inappropriate collaboration
- Plagiarism
- Misrepresenting or fabricating data or results or other assessable work
- Inappropriate electronic data sourcing/collection
- Breaching rules specified for the conduct of examinations in a way that may compromise or defeat the purposes of assessment.

Penalties for academic misconduct vary according to seriousness of the case, and may include the requirement to do further work or repeat work; deduction of marks; the award of zero marks for the assessment; failure of one or more units; suspension from a course of study; exclusion from the University, non-conferral of a degree, diploma or other award to which the student would otherwise have been entitled.
Refer to the Ethical Scholarship, Academic Literacy and Academic Misconduct and individual Faculty policies.

Laboratory Conduct

Once permitted access to the Mechatronics Laboratories (G19 and possibly G21), students are also provided Building access 24 hours, 7-days a week, permitting them to work on Laboratories and project work. Students must obey the laboratory safety rules, reviewed in the Safety training induction and documented in the Laboratory safety manual. Importantly, at no time are students to work alone in the laboratory after hours. At least 2 students must be present in the Laboratory at all times. Any violation of the safety rules for his laboratory may result in removal of building and room access privileges.

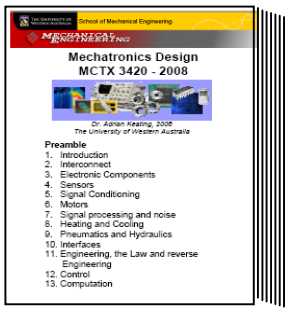
Appeals against academic assessment

If students feel they have been unfairly assessed, they have the right to appeal their mark by submitting an Appeal Against Academic Assessment form to the Head of School and Faculty Office. The form must be submitted within **twelve working days** of the formal despatch of your unit assessment. It is recommended that students contact the Guild Education Officers to aid them in the appeals process. They can be contacted on +61 8 6488 2295 or education@guild.uwa.edu.au. Full regulations governing appeals procedures are available in the University Handbook, available online at http://www.publishing.uwa.edu.au/handbooks/interfaculty/PFAAAA.html.

TEXTBOOK(S) & RESOURCES

Unit Website

http://www.mech.uwa.edu.au/mechatronics/MD



Recommended/required text(s)

Notes (Reader) available from the Guild Bookshop

Technical requirements

Students require access required to G19 for Laboratory and Project work. To gain access, students must complete safety training for this laboratory. Once permitted access, students are also provided Building access 24 hours, 7-days a week, permitting them to work on Laboratories and project work. Students may also require access to G23 computer laboratory may also be necessary . students will require a login account. If login access has not previously been obtained students must request an account from the Mechanical engineering front office.

Safety Training/Laboratory Induction

Students require access required to G19 for Laboratory and Project work. To gain access, students must complete safety training for this laboratory and read and understand the Laboratory safety manual. Four Laboratory safety training sessions are held in G.19 during the 1st week before keys are assigned for access to G19. Times for the training will be indicated on a Sign up sheet on the Door to G19. **Student must sign up in the first week.** No more than 15 students per session.

Keys available after safety session sign-off from the Mech front office (2nd floor) but only before 10 am each day.

Software requirements

Experience with word and excel. PowerPoint required for final project presentations. Access to matlab recommended to complete some tutorial assignments, Lab work and Project work.

Additional resources & reading material

- **Laboratory:**

  Datasheets – IN125A (see website)

- **Project work**

  Journals, Books and Website as relevant to project

Borrowing and Using Reading Material Available in Mechatronics Laboratory (G.19)

Please note that any material in the Mechatronics Laboratory can be borrowed on an *overnight* basis only - you must write your name and telephone number in the loans book near the door.

Journals in the Mechatronics Laboratory are personal copies of the academics from the Mechatronics Discipline. Please respect this. Not all the journals in the laboratory are held in the UWA library.

UNIT STRUCTURE

Overview

Lectures 1 hour per week

1. Functional Block Diagrams + Specifications
2. Interconnect
3. Electronic Components
4. Sensors
5. Signal Conditioning
6. Motors
7. Signal processing
8. Noise
9. Heating and Cooling
10. Pneumatics and Hydraulics
11. Interfaces
12. Engineering, the Law and reverse Engineering
13. Control
14. Computational issues and tools

- Tutorials (Approx 10-15 students per tutorial)

  Weekly, related to the specific weekly Lecture topic as described above

  Tutorials are either a one 45 minutes session or two-back-to-back 45 minute sessions, depending on the work to be covered. Two back-to-back time slots have been scheduled (the second session is not always used)

- Safety training for Mechatronics Laboratory induction

  - Approximately 20 minutes. The exact dates and times will be announced by the unit coordinator. **Note: You need to attend the safety induction session to get access to the Mechatronics Laboratory.**

- Lab 1: (Team of 2) Sensor and Relay - soldering, assembly and applications –Due: End of Week 33
- Lab 2: (Team of 2) Strain Gauge Due: End of Week 39

  Kits have been assembled for these Labs and are available from

  Reinier de Lange - Mech Eng Senior Technician
  rdelange@mech.uwa.edu.au
  (+61 8) 6488 7098
  Room G57

Note that Lab 2 Kits can only be picked up once Pre-lab questions have been handed in.

- Projects: (Team of 2-MCTX3420, 2-MCTX2420) See project list and other information on website indicated under TEXTBOOK(S) & RESOURCES

  Deliverables/Reports:

- Fortnightly Reports
- Scoping Report
- Final report (written)
- Final presentation
- Confidential reports

- Site Visits – two site visits have been organised allowing up to 15 student in each session. These visits are graded.

UNIT SCHEDULE

The unit is OLCR (On-Line Class Registration) and WEBCT enabled. Please use OLCR to register your timetable preferences.

Major Tasks to Undertake in the in the 1st week of the Semester

1) Read The Guide to Project Work on the MD website.

2) Pick up the Mechatronics Design notes from the guild bookshop. Review Chapter 1 of the Mechatronics Design notes.

3) "Enrol in"/assemble the project team. Assign a meeting convener and chose a regular meeting time and submit your project request. Note that Project Request Report must be submitted by **Thursday Week1 5 pm** (WAST). This implies that the project teams must be assembled well before this deadline as you need time to write Project Request Report. Use WebCT to contact your team and discuss projects. Also, attend the first team allocated/timetabled Laboratory_Project_Work Session to meet your team and confirm team details (meeting times, desired projects, exchange contact details).

4) Sign up for safety training for G19 and read the Mechatronics Lab. Operational and Safety document on the MD website. Subsequently attend the safety training for G19 access and then pick up the key to G19 from the Mech Eng front office (before 10am only).

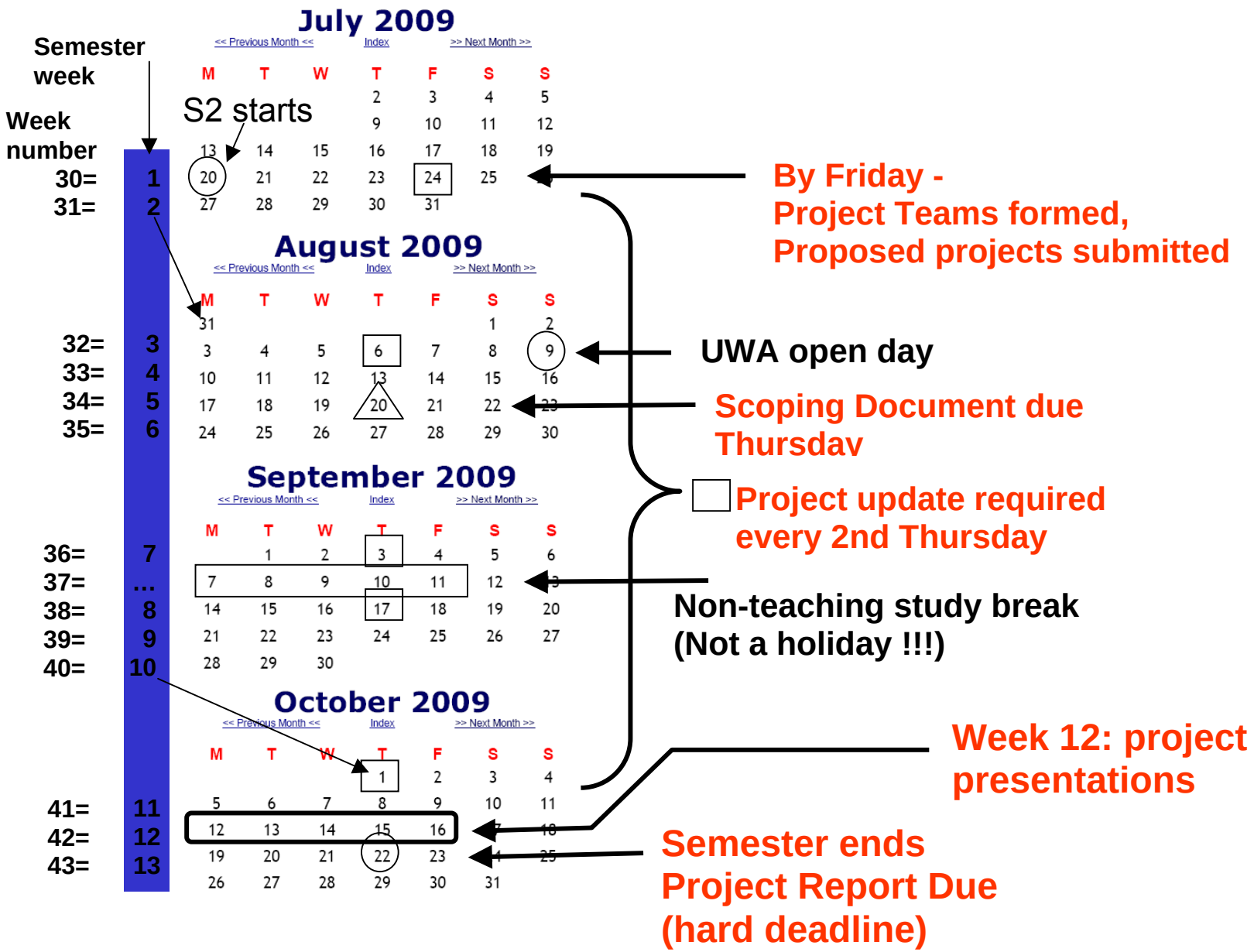
5) Confirm your Laboratory team mate (same as you Project team member in MD in most cases) and Pick up the Kits for Lab #1 from Reinier de Lange - Mech Eng Senior Technician in Rm G57.

6) Read the detailed schedule provided for the unit: it provides guidance to help you with your work each week.

Mechatronics Design - 2009 Course Schedule

Revision: August 5th 2009

			Lecture: Monday 10am	Tutorial: Wednesday, Friday	Deadlines	suggestions: Projects and Labs
wk	sem. week			1 hour every week		8 hours each week
30	1		**Pre-amble and Introduction: Functional Blocks**	Functional Diagrams	Form teams, submit your **project request due Friday COB** Safety Briefing / key picked up Pickup Lab1 & start Lab.	PROJECT: Select projects, select meeting convenor, chose meeting times, discussion project requirements, LAB pick up kits
31	2		**Interconnect**	Soldering and PCB fab	Tute assignment	PROJECT: Identify tasks requires to be done by each team member, create function diagram for system, LAB - Complete soldering on PCB and stuff the PCB
32	3		**Electronic Components**	Limts of Electronics, inductive loads and sparks & Project Review	Fortnightly Report Due	PROJECT: Detail the entire system requirements, sub-divide into sub-components, determine deliverables from each team member , LAB: test VI interface, record results and write up
33	4		**Sensors**	Relflective sensor & PCB encoder, temp sensors, MEMS pressure sensors	**Lab 1 Due Friday COB**	PROJECT: Prepare project scoping document, ensure all interfaces are defined, LAB: Submit LaB1 Complete Pre-lab LAB2 and pick up Kit
34	5		**Signal Conditioning**	Open loop analysis, Capacitive sensing, Bal & Unbalanced sensing	**Project Scoping Report Due Friday**	PROJECT: Feasibility studies required, start drawings mechanical, electrical , software, order samples or any parts required, LAB2: Place Strain gages on Load Cell and Solder up, Solder up Strip board and test
35	6		**Motors**	Measure motor speed, current, commutor layout, DC and induction motor	Tute assignment, **All Lab 2 Pre labquestions DUE.**	PROJECT: Results from feasibility, move to phase 1 investgations, firm up drawings, LAB2: complete Load cell testing and Calibration and VI nterface results
36	7		**Signal processing**	Understanding ADCs, filter design, conversion to digital form ,Review Basis of Fourier Transforms and impulse response	Fortnightly Report Due	PROJECT: Finalized drawing and submit to workshops - they need at least 4 weeks to complete, Lab 2: Start debugging of circuit
37			**Mid Semester Teaching Break** (Not a holiday - This iis project and Lab catch up time !!)			
38	8		**Noise**	Motor noise coupling, coupling to cables	Fortnightly Report Due	PROJECT: Start write up for Lab 2
39	9		**Heating and Cooling**	Infrared camera, Diode heating, fuses, Derating	**Strain Gauge (Lab 2) Report Due Friday COB** Weekly Report Due	PROJECT: Complete Lab 2
40	10		**Pneumatics and Hydraulics**	Reading circuits, Regulators, buckling	Fortnightly Report Due	PROJECT: Prepare documentation for Projects, ensure Wiki is up to date
41	11		**Interfaces**	RS232, ringing in transmission lines microcontrollers, using multimeters	Tute assignment	PROJECT: Prepare final reports and demonstrations
42	12		**Engineering, the Law and reverse Engineering**	Reverse Engineering, standards, Safety Issues	**Week 12 - Project demonstrations and assessment**	PROJECT: Complete project report drafts
43	13		**Control**	Effects of delays, digital filters, Z-domain, parasitic capacitance	**Deadline for final reports COB Friday**	PROJECT: Finalize project report
44	14		**Swot Vac Week**			
45			**November Examinations (Not relevant for MD)**			
46						


Semester week
Week number
July 2009
<< Previous Month << Index >> Next Month >>
M T W T F S S
S2 starts
30= 1
31= 2
August 2009
32= 3
33= 4
34= 5
35= 6
September 2009
36= 7
37= …
38= 8
39= 9
40= 10
October 2009
41= 11
42= 12
43= 13
By Friday -
Project Teams formed,
Proposed projects submitted
UWA open day
Scoping Document due
Thursdav
Project update required
every 2nd Thursday
Non-teaching study break
(Not a holiday !!!)
Week 12: project
presentations
Semester ends
Project Report Due
(hard deadline)