MONASH University

Unit Guide

ECE4808
Organic electronics and micro devices

Semester 2, 2017

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Unit handbook information

Synopsis

The unit introduces basic theory behind the organic electronics and micro technologies related to micro sensors, micro actuators and organic devices such as Organic LEDs (OLEDs). The topics include study of materials used in organic electronics and MEMS, study of their electrical and mechanical properties, basic structures in micro devices such as cantilever beams and comb structures, the fabrication techniques involved in manufacturing micro and nano structures, and measurement techniques suitable for characterising micro devices. Examples will include principles of physical sensors; piezoelectric effect based microsensors; chemical microsensors; OLED devices; MEMS and microsystems computer based simulations. An elementary part of the unit will be the laboratory exercises and project work to produce micro devices and construct suitable electronic circuits/simulate to demonstrate their applications.

Mode of delivery

Malaysia (Day)

On Campus

Workload requirements

Lectures: 3 hours per week
Tutorials: 1 hour per week
Laboratory: 2 hours per week

Unit relationships

Prerequisites

ECE 2061

Prohibitions

None

Co-requisites

None

Chief Examiner(s)

Professor Manos Varvarigos

Unit Coordinator(s)

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Campus Coordinator

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Lecturer(s)

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Demonstrator(s)

Mr. Lee Neam Heng

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(Tutor)

Academic Overview

Program Education Objectives
The Electrical and Computer Systems engineering discipline expects to produce graduates, who are:
1. competent in Electrical and Computer Systems engineering
2. responsible and effective global citizens
3. leaders in their chosen profession or society at large.

Program Outcomes
The Electrical and Computer Systems engineering discipline has developed a set of Program Outcomes (POs) for all of its graduates based on the competencies required by the Malaysian Engineering Accreditation Council.

Program Outcomes (POs)	Activities used in this unit to develop POs, achievement of Bloom's domains and complex problem solving
PO1 **Electrical and Computer Systems Engineering Knowledge:** Apply knowledge of mathematics, natural science, engineering fundamentals and specialisation in Electrical and Computer Systems engineering to the solution of complex engineering problems	Cognitive: Lectures, Lab exercises, preliminary quizes, Field trip
PO2 **Problem Analysis:** Identify, formulate, survey research literature and analyse complex Electrical and Computer Systems engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences	Cognitive: Not applicable
PO3 **Design/Development of Solutions:** Design solutions for complex Electrical and Computer Systems engineering problems and design systems, components or processes that meet specified needs.	Cognitive: Lectures, Lab exercises on modeling/simulation Psychomotor: Lab exercises on microfabrication/measurement, Miniproject exercise
PO4 **Research-based Investigation:** Conduct investigations of complex Electrical and Computer Systems engineering problems using research-based knowledge and research methods including design of experiments, (analysis and interpretation of data, and synthesis of information to provide valid conclusions.	Cognitive: Lectures, Lab exercises
PO5 **Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex Electrical and Computer Systems engineering problems, with an understanding of the limitations	Cognitive: Lab exercises on using COMSOL Multiphysics to model and simulate micro devices Psychomotor: Not applicable

Program Outcomes (POs)	Activities used in this unit to develop POs, achievement of Bloom's domains and complex problem solving
PO6 **Engineer and Society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solutions to complex Electrical and Computer Systems engineering problems	Affective: Not applicable
PO7 **Environment and Sustainability:** Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex Electrical and Computer Systems engineering problems in environmental contexts.	Cognitive: Not applicable Affective: Not applicable
PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.	Affective: Not applicable
PO9 **Communication:** Communicate effectively on complex Electrical and Computer Systems engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	Affective: NA
PO10 **Individual and Team work:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings	Affective: Miniproject, Research proposal
PO11 **Lifelong Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	Affective: Research proposal
PO12 **Project Management and Finance:** Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to manage projects	Cognitive: Not applicable Affective: Not applicable

Teaching and learning method

Lecture and tutorials or problem classes; seminars; laboratory-based classes; research activities; field trips; simulation or virtual practice.

Learning outcomes

At the completion of the unit, students will be able to:

1. Interpret and summarise the principles, instrumentation, theory, mathematical models, simulation techniques, fabrication and manufacturing techniques related to Microelectromechanical Systems (MEMS) and Organic electronics based devices
2. Design and develop simple MEMS devices, organic electronic devices (such as Organic Light Emitting Diode) and theoretical models involving multi physics
3. Select suitable electronic components and develop simple MEMS or Organic electronic device based systems, evaluate structural and material properties of Micro/Nano devices through simulation studies
4. Summarise fundamentals of nanotechnology and propose research opportunities in designing Micro technologies

OBE requirements to learning outcomes (LOs)

Learning Outcomes (LOs) for Outcome Based Education (OBE) requirements	*Handbook Learning Outcomes (LOs)*
LO1) **Interpret** and **describe** the principles, instrumentation and manufacturing techniques related to Microelectromechanical Systems (MEMS) and Organic electronics based devices.	LO1) Interpret and summarize the principles, instrumentation, theory, mathematical models, simulation techniques, fabrication and manufacturing techniques related to Microelectromechanical Systems (MEMS) and Organic electronics based devices.
LO2) **Design** microdevices and predict the characteristics using modeling and simulation tools	LO2) Design and develop simple MEMS devices and Organic electronic devices (Such as Organic Light Emitting Diode), theoretical models involving multiphysics.
LO3) **Select** electronic materials and components to **construct** simple MEMS or Organic device as a solution for a given complex engineering problem and further **practice** handling these materials while fabrication process.	LO3) Select suitable electronic components and develop simple MEMS or Organic electronic device based systems, evaluate structural and material properties of Micro/Nano devices through simulation studies
LO4) **Evaluate** structural and material properties employed in Micro devices using research based methods.	LO3)Select suitable electronic components and develop simple MEMS or Organic electronic device based systems, evaluate structural and material properties of Micro/Nano devices through simulation studies
LO5) **Apply** fundamentals of nano/microtechnology for developing sustainable electronic devices	LO4)Summarize fundamentals of nanotechnology and propose research opportunities in designing Micro technologies.
LO6) **Initiate** research ideas to advance in the areas of micro and or organic device technologies.	LO4)Summarize fundamentals of nanotechnology and propose research opportunities in designing Micro technologies.

Learning Outcomes (LOs) for Outcome Based Education (OBE) requirements	*Handbook Learning Outcomes (LOs)*
LO7) **Assume responsibility** in team work to **carry out** microfabrication process /characterization while manufacturing micro devices.	LO2) Design and develop simple MEMS devices and Organic electronic devices (Such as Organic Light Emitting Diode), theoretical models involving multiphysics.

Relationship between Unit Learning Outcomes and Program Outcomes

No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
LO1	√											
LO2					√							
LO3			√									
LO4				√								
LO5							√					
LO6											√	
LO7										√		

Your feedback to us

One of the formal ways students have to provide feedback on teaching and their learning experience is through the Student Evaluation of Teaching and Units (SETU) survey. The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied with and areas for improvement.

Previous student evaluations of this unit

In response to previous SETU results of this unit, the following changes have been made:

There were concerns about the organisation of the unit. Lecturer will make additional effort to deliver in the best possible way.

Student feedback has highlighted the following strength(s) in this unit:

Generally the Unit is well appreciated by the students.

Field trip and fresh topics in the unit are welcomed by students' in the previous offerings

If you wish to view how previous students rated this unit, please go to:
https://unitevaluations.connect.monash.edu.au/unitevaluations/index.jsp

Unit schedule

Week	Activities	Assessment
0	Orientation Week	No formal assessment is undertaken in week 0
1	**Lecture:** Introduction to Microelectromechanical Systems (MEMS), working principles of micro systems: Micro Sensors and Actuators **Lab:** No Lab	No assessment
2	**Lecture:** Scaling laws in miniaturization, Micro structures, Mechanical terms, modeling methods. **Lab 1:** Literature review and exploring Micro and Nano Technology	Tutorial and Lab: Lab 1 Demonstration, Quiz - 1
3	**Lecture:** Materials used in MEMS,Nano devices, and Organic electronics. Micro mechanics: Stress and strain, Bending of thin plates and beams **Lab 2:** COMSOL Lab - Basic drawing practice of MEMS structures and exploring software	Tutorial and Lab: Lab 2 Demonstration, Quiz - 2
4	**Lecture:** Micro mechanics contd: Micro resonant devices, electrostatic force, Electric field: Conductivity. **Lab 3:** COMSOL Lab- Simple MEMS Structure design and Analysis	Tutorial and Lab: Lab 3 Demonstration, Quiz - 3

5	**Lecture:** Piezoelectric micro devices and acoustic sensors. **Lab 4:** COMSOL Simulation of a micro sensor and application– Multiphysics demonstration	Tutorial and Lab: Lab 4 Demonstration, Quiz -4
6	**Lecture:** Micro-nanofabrication techniques for MEMS and organic devices. **Tutorial and Lab 5:** COMSOL Simulation of a Micro Actuator and analysis	Tutorial and Lab: Lab 4 Demonstration, Quiz -5, Research Idea Proposal
7	**Lecture:** Micro manufacturing technology, issues. **Tutorial and Lab 6:** Micro and Nano Devices Lab Tour.	Mid Sem Test & Micro and Nano Devices Lab Tour based Quiz - 6
8	**Lecture:** Molecular electronics: Introduction, Basic concepts, conductive polymers, Applications: Sensors **Tutorial and Lab 6:** Thin film fabrication / Photo Lithography /Measurement	Clean room / Fabrication Lab/ Measurement - Lab 5 Demo, Quiz 7 Tentative Industry visit report
9	Lecture: Organic Light Emitting Diodes (OLED), Organic Solar cells. **Lab 7:** Thin film fabrication / Photo Lithography /Measurement	Clean room / Fabrication Lab/ Measurement - Lab 6 Demo, Quiz 8
10	**Lecture:** Introduction to Nanotechnology Instrumentation **Lab 8:** Miniproject task	Clean room / Fabrication Lab/ Measurement - Lab 7 Demo, Quiz 9

11	**Lecture:** Electronic engineers role in Nanotechnology **Lab 9:** Mini project completion	Clean room / Fabrication Lab/ Measurement, Mini Project Work Miniproject report submission by end of the week.
12	**Lecture:** Advancement to Flexible and wearable electronics. **Lab:** No Lab	Practice Lab sessions.
	SWOT VAC	No formal assessment is undertaken in SWOT VAC
	Examination period	LINK to Assessment Policy: www.policy.monash.edu /policybank/acad emic/education /assessment/assessment- in-coursework-policy.html

Assessment requirements

Assessment summary

Continuous assessment: 50%
Examination (2 hours): 50%
Students are required to achieve at least 45% in the total continuous assessment component (assignments, tests, mid-semester exams, laboratory reports) and at least 45% in the final examination component and an overall mark of 50% to achieve a pass grade in the unit. Students failing to achieve this requirement will be given a maximum of 45% in the unit.

Assessment task	Value	Due date
Mid Sem Test (Test- Continuous Assessment)	10 %	Week 7
Preparation Quiz (Continuous assessment)	10 %	Tutorial (to be completed prior to start of the lab)
Laboratory exercises - demonstration and reports (Continuous Assessment)	10 %	Friday of Week 2 to Week 10.
Mini-Project/Case Studies (Continuous Assessment)	12 %	Week 11
Research idea proposal (Continuous assessment)	5 %	week 6

Assessment task	Value	Due date
Field Trip :Industry visit observation - Continuous Assesment	3 %	One week from the visit date
Final Examination	50%	To be advised

Bloom's Taxonomy:
Three domains of educational activities have been identified under the general taxonomy known as Bloom's.

- **Cognitive**: mental skills (*Head*)
- **Affective**: growth in feelings or emotional areas (*Heart*)
- **Psychomotor**: manual or physical skills (*Hand*)

The *cognitive* domain involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills.

The *affective* domain includes the attitudes with which someone deals with things emotionally, such as feelings, values, appreciation, enthusiasms and motivations.

The *psychomotor* domain includes physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution.

Key for the LO-assessment relationship table above:

Cognitive

C1	C2	C3	C4	C5	C6
Knowledge: Remembers previously learned material	**Comprehension:** Grasps the meaning of material (lowest level of understanding)	**Application:** Uses learning in new and concrete situations (higher level of understanding)	**Analysis:** Understands both the content and structure of material	**Synthesis:** Formulates new structures from existing knowledge and skills	**Evaluation:** Judges the value of material for a given purpose

Psychomotor

P1	P2	P3	P4	P5	P6	P7

Perception: Senses cues that guide motor activity	**Set:** Is mentally, emotionally and physically ready to act	**Guided Response:** Imitates and practices skills, often in discrete steps	**Mechanism:** Performs acts with increasing efficiency, confidence and proficiency	**Complete Overt Response:** Performs automatically	**Adaption:** Adapts skill sets to meet a problem situation	**Organisation:** Creates new patterns for specific situations

Affective

A1	A2	A3	A4	A5
Receiving: Selectively attends to stimuli	**Responding:** Responds to stimuli	**Valuing:** Attaches value or worth to something	**Organisation:** Conceptualises the value and resolves conflict between it and other values	**Internalising:** Integrates the value into a value system that controls behaviour

Relationship between Assessments and OBE Learning Outcomes (LOs)

Assessment	LO1	LO2	LO3	LO4	LO5	LO6	LO7
Mid Sem Test (Test- Continuous Assessment)	C6	C5					
Preparation Quiz (Continuous assessment)	C2						
Laboratory exercises - demonstration and reports (Continuous Assessment)		C5	P3				
Mini-Project/Case Studies (Continuous Assessment)							A3, C3
Research idea proposal (Continuous assessment)						A3	
Field Trip :Industry visit observation - Continuous Assessment	C2						
Final Examination	C6		C6	C6	C3		

Relationship between Assessments and Complex Problems /Activities

	Assessment	Complex Problems	Complex Activities

		Depth of Knowledge	Range of Requirements	Depth of Analysis	Infrequent Issues	Extent of Codes	Stakeholder Involvement	Components or Sub-problems	Range of Resources	Level of Interactions	Innovation	Consequences to Society and Environment	Unfamiliarity
1	Mid Sem Test (Test-Continuous Assessment)	x											
2	Preparation Quiz (Continuous assessment)	x	x										
3	Laboratory exercises - demonstration and reports (Continuous Assessment)		x	x	x				x				
4	Mini-Project /Case Studies (Continuous Assessment)			x					x				
5	Research idea proposal (Continuous assessment)			x									
6	Field Trip : Industry visit observation - Continuous Assessment	x											
7	Final Examination	x	x	x	x								

Hurdle requirements

UNIT HURDLE: A minimum of 50 % in total 100 % has to be achieved to pass the unit.

A minimum of 45 % should be achieved for combined continuous assessment task (Mid sem test, Laboratory exercises - demonstration and reports,Mini-Project/Case Studies, Research idea proposal,Field Trip :Industry visit observation,Preparation Quiz,

Assessment tasks

Assessment title: Mid Sem Test (Test- Continuous Assessment)
Mode of delivery: Written test or online test in Lab (open book)
Details of task: A mid term test will be conducted covering 70 % of Lab activities and 30 % of lectures.
Release dates (where applicable): Week 7
Word limit (where applicable): N/A
Due date: Week 7
Value: 10 %
Presentation requirements: N/A
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): N/A
Criteria for marking: Marking based on question paper
Additional remarks: N/A

Assessment title: Preparation Quiz (Continuous assessment)
Mode of delivery: Online moodle quiz
Details of task: Every week student need to take online quiz based on the reading material and lab excercise (prelim)
Release dates (where applicable): Every week 1 to 10 (Friday)
Word limit (where applicable): N/A
Due date: Tutorial (to be completed prior to start of the lab)
Value: 10 %
Presentation requirements: N/A
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): N/A
Criteria for marking: Online quiz, 1 or 0
Additional remarks: N/A

Assessment title: Laboratory exercises - demonstration and reports (Continuous Assessment)
Mode of delivery: Written or moodle submission
Details of task: Lab: Reports
Release dates (where applicable): Every week announcement will be made through email
Word limit (where applicable): Nil
Due date: Friday of Week 2 to Week 10.
Value: 10 %
Presentation requirements: N/A
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): N/A
Criteria for marking: Described in lab sheets
Additional remarks: N/A

Assessment title: Mini-Project/Case Studies (Continuous Assessment)
Mode of delivery: To be carried out during lab sessions and private study
Details of task: Student should form teams consisting of 3 members. A topic will be announced in week 2, team need to work towards the goal proposed by the unit lecturer.
Release dates (where applicable): Week 2
Word limit (where applicable): N/A
Due date: Week 11
Value: 12 %
Presentation requirements: Detailed rubrics and marking scheme will be sent through email

Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): Mutual assessment sheet should be filed by every member and overall impression part of the miniproject assessment will be calculated based on the peer review assessment.

Criteria for marking: Will be announced during Week 6 lecture
Additional remarks: N/A

Assessment title: Research idea proposal (Continuous assessment)
Mode of delivery: Online submission,
Details of task: The teams should discuss each other and propose a project based on the theme announced by the lecturer during week 2 lab session. The team should be able to identify the role of each member in the proposal.
Release dates (where applicable): week 2
Word limit (where applicable): 5 pages
Due date: week 6
Value: 5 %
Presentation requirements: N/A
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): Mutual assessment sheet should be filed by every member .
Criteria for marking: Rubrics and marking scheme will be announced by week 3.
Additional remarks: N/A

Assessment title: Field Trip :Industry visit observation - Continuous Assesment
Mode of delivery: One page report on the field trip observation to be submitted to moodle.
Details of task: Student will be taken to a microelectronics related industry to witness and observe the industry level micro device manufacturing process. They need to attempt a short quiz and or a report to be submitted through moodle
Release dates (where applicable): Subjective to appointment from Industry person
Word limit (where applicable): one page
Due date: One week from the visit date
Value: 3 %
Presentation requirements: N/A
Hurdle requirements (where applicable): N/A
Individual assessment in group tasks (where applicable): Mutual assessment sheet should be filed by every member.
Criteria for marking: Marking scheme will be announced through email.
Additional remarks: N/A

Examination(s)

Exam title: Final Examination
Weighting: 50%
Length: 2 hours
Type (Open/closed book): Closed
Hurdle requirements (where applicable): 22.5 % out of allotted 50 %
Electronic devices allowed: University approved calculators
Remarks (where applicable):

ode of Delivery: Written
Details of task: Questions based on anything covered during the unit offering semester

Calculators
A list of the Faculty of Engineering approved calculators and the process for obtaining a sticker is available online at:
http://www.eng.monash.edu.au/current-students/calculators.html

IMPORTANT: Only these listed calculators with the **authorised Monash University-Science or Monash University-Engineering STICKER** will be allowed into the examination by the invigilators.

Extensions and penalties

Updated during lecture

Returning assignments

Moodle

Resubmission of assignments

Lecturer will advise if there any re-submission is required.

Plagiarism and collusion

Intentional plagiarism or collusion amounts to cheating under Part 7 of the Monash University (Council) Regulations.

Plagiarism: Plagiarism means taking and using another person's ideas or manner of expressing them and passing them off as one's own. For example, by failing to give appropriate acknowledgement. The material used can be from any source (staff, students or the internet, published and unpublished works).

Collusion: Collusion means unauthorised collaboration with another person on assessable written, oral or practical work and includes paying another person to complete all or part of the work. Where there are reasonable grounds for believing that intentional plagiarism or collusion has occurred, this will be reported to the Associate Dean (Education) or delegate,

Referencing requirements

To build your skills in citing and referencing, and using different referencing styles, see the online tutorial Academic Integrity: Demystifying Citing and Referencing at http://www.lib.monash.edu.au/tutorials/citing/

Assignment submission

Hard Copy Submission:

Assignments must include a cover sheet. The coversheet is accessible via the Monash portal page located at http://my.monash.edu.au under the heading 'Learning and teaching tools'. Please keep a copy of tasks completed for your records.

You can submit in the pigeon hole with label ‘Dr. Ramakrishnan” available in Building 2, Level 4 School of IT staff mail box.

Online Submission: If Electronic Submission has been approved for your unit, please submit your work via the Moodle site or other; as directed by your demonstator for this unit.
Please keep a copy of tasks completed for your records.

Feedback to you

Feedback will be provided in following ways

- written comments
- verbal comments
- feedback to the whole class, to groups, to individuals

Learning resources

Recommended textbooks

Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, 2002 (Second Edition)

Chang Liu, Foundation of MEMS, Pearson Prentice Hall, Illinois ECE Series, 2006

Monash Library Unit Reading List (if applicable to the unit):
http://readinglists.lib.monash.edu/index.html

Required resources

Students generally must be able to complete the requirements of their course without the imposition of fees that are additional to the student contribution amount or tuition fees. However, students may be charged certain incidental fees or be expected to make certain purchases to support their study. For more information about this, go to Administrative Information for Higher

Education Providers: Student Support, Chapter 21, Incidental Fees at: http://www.innovation.gov.au/HigherEducation/TertiaryEducation/ResourcesAndPublications/Pages/default.aspx

Students are recommended to record lecture notes, laboratory observations, Tutorial notes Journal articles posted in the unit Moodle page.

Technological requirements

Students must regularly check Moodle for announcements.

Additional unit costs

Local transport will be arranged for the trip and other cost such as food will be borne by the student.

Field trips

There will be a half day to one day industrial visit. Students will be exposed to industry level instruments and equipment's used for micro device fabrication. Report/Quiz will be marked as a continuous assessment. If a student has a medical or emergency reason can be exempted from field trip upon appropriate evidence, In that case alternative test will be conducted for assessment.

Other information

Policies

Monash has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University's academic standards, and to provide advice on how they might uphold them. You can find Monash's Education Policies at: http://www.policy.monash.edu/policy-bank/academic/education/index.html

Graduate Attributes Policy

http://www.monash.edu/policy-bank/academic/education/course-governance-and-design/course-design-policy

Student Charter

http://www.monash.edu/students/policies/student-charter.html

Student Services

The University provides many different kinds of services to help you gain the most from your studies. Contact your tutor if you need advice and see the range of services available at: http://www.monash.edu.my/Student-services/

Monash University Library

The Library and Learning Commons, Monash University Malaysia Campus, provides a range of services and resources that enable you to save time and be more effective in your learning and research.
Go to http://www.lib.monash.edu.my or the library tab in my.monash portal for more information.

Disability Support Services

Students who have a disability, ongoing medical or mental health condition are welcome to contact Disability Support Services.

Disability Support Services also support students who are carers of a person who is aged and frail or has a disability, medical condition or mental health condition.

Disability Advisers visit all Victorian campuses on a regular basis.

- Website: monash.edu/disability
- For information and referral, telephone: Student Adviser, Student Community Services at 03 55146018
- Drop In: Student Community Services Department, Level 2 Building 2, Monash University Malaysia Campus
- Email: disabilitysupportservices@monash.edu (Disability Support Services, Monash University Australia)