

Nanyang Science and Engineering Experience

A Premium Enrichment Programme

Module Synopses 2021

CONTENTS / MODULE SCHEDULE

DAY / DATE	MODULE CODE	MODULE TITLE	LECTURER(S)	Duration	9.30AM – 1.00PM	2.00PM – 5.30PM	Page
31 May 2021 Monday	EEE/1	Introduction to Aerial Robotics	Xie Lihua (Prof) Yuan Shenghai (Dr) Nguyen Thien-Minh (Dr)	3.5 hrs	✓		3
	SCBE/1	Introduction to Chemical Process Simulation in Aspen Hysys	Mukta Bansal (Dr)	3.5 hrs		✓	3
1 June 2021 Tuesday	SCSE/1	Raspberry Pi and Python Programming	Nicholas Vun (Assoc Prof)	7.0 hrs	✓	✓	4
	MSE/1	Introduction to Materials Selection using Cambridge Educational Software	Oh Joo Tien (Assoc Prof)	3.5 hrs	✓		4
	CEE/1	Dimensional Analysis in Hydraulics Engineering	Lim Siow Yong (Assoc Prof)	3.5 hrs		✓	5
2 June 2021 Wednesday	SBS/1	Structural Biochemistry	Surajit Bhattacharyya (Assoc Prof)	7.0 hrs	✓	✓	6
3 June 2021 Thursday	CBC/1	Be a Molecular Detective for a Day – Theory and hands on experience on a benchtop NMR Spectrometer	Sumod Pullarkat (Dr)	7.0 hrs	✓	✓	7
4 June 2021 Friday	MAE/1	Taking Inspiration from Nature in Building Tomorrow's World	Hortense Le Ferrand (Asst Prof)	3.5 hrs	✓		8
	MAS/1	Discrete Mathematics and Statistics with Applications	Bernhard Schmidt (Prof)	3.5 hrs	✓		8
	MAS/2	Gems of Number Theory	Lim Kay Jin (Dr) Wang Jialin (Ms)	3.5 hrs		✓	9

* Lunch break will run from 1.00pm – 2.00pm

EEE/1
31 May 2021 (Monday)

Title	Introduction to Aerial Robotics
Description	Students will be introduced to a UAV called Tello and trained to control the Tello drone using python scripts. The learning environment is a friendly, hands-on session where students can play with the drone all the time in small groups. There will be instructors there to answer any questions. There are a few five minutes briefing sections in between the modules to introduce the concept and share the sample code. There will be a competition in which students can demonstrate what they learn and have cool demos.
Lecturer	Prof Xie Lihua / Dr Yuan Shenghai / Dr Nguyen Thien-Minh
Mode of Delivery	Lecture / Laboratory
College / School	College Of Engineering / Electrical and Electronics Engineering
Date	31 May 2021
Time (Duration)	9.30 am – 1.00 pm (3.5 hrs)
Module Cap	12 students


SCBE/1
31 May 2021 (Monday)

Title	Introduction to Chemical Process Simulation in Aspen HYSYS
Description	We all learn about the chemistry of reactions (rate equations, rate constant, order of reaction, equilibrium, etc.) in A level Chemistry. Have you ever wondered where do chemical reactions fall in the scheme of things in a chemical plant? Do you know that the life of a Chemical Engineer can also be exciting? Chemical engineering is not just about experiments, but also about playing with simulation software. In this module, we shall look into various parts of a chemical plant. We shall employ the Aspen HYSYS modelling platform - a user-friendly and exciting tool - to simulate and understand the operation of different parts of chemical plants. This module shall incorporate a combination of lectures and hands-on simulation sessions. The broad aim of this module is to give students a light appreciation of some core chemical engineering fundamentals with the aid of typically used simulation tools.
Lecturer	Dr Mukta Bansal
Mode of Delivery	Lecture / Laboratory
College / School	College of Engineering / School of Chemical and Biomedical Engineering
Date	31 May 2021
Time (Duration)	2.00 pm – 5.30 pm (3.5 hrs)
Module Cap	12 students



SCSE/1

1 June 2021 (Tuesday)

Title Raspberry Pi and Python Programming

Description This module will introduce students to coding based on the Python programming language. The class will be conducted in workshop style with hands-on programming exercises done on the Raspberry Pi board. Students with no prior programming experience will first learn about the basic concepts in developing a program, and be guided to eventually develop a fun game running on the Raspberry Pi board.

Lecturer Assoc Prof Nicholas Vun

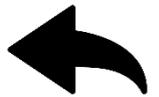
Mode of Delivery Laboratory

College / School College Of Engineering / School of Computer Science and Engineering

Date 1 June 2021

Time (Duration) 9.30 am – 5.30 pm (7.0 hrs)

Module Cap 30 students



MSE/1

1 June 2021 (Tuesday)

Title Introduction to Materials Selection using Cambridge Educational Software

Description Materials Science is a field of study that relates the properties of materials to its structure at the atomic, microscopic and macroscopic levels. Understanding this relationship helps to achieve the required combination of properties in a given material for a specific application. For example, materials scientists and engineers have discovered and are continuously innovating the best materials for fire-retardant clothes, solar panels, microchip devices and drug-delivery capsules.

This is a module that will cover physics and chemistry concepts in relation to electrical and magnetic materials. Application of materials in engineering solutions in daily life will be highlighted. Students will also be introduced to materials selection in design of products using CES EduPack™ 2018 software developed by Professor Mike Ashby of Cambridge University. This aids in the understanding of relationships between materials process, structure and properties, as well as materials selection tools to support the design of engineering devices.

Lecturer Assoc Prof Oh Joo Tien

Mode of Delivery Lecture / Laboratory

College / School College Of Engineering / School of Materials Science & Engineering

Date 1 June 2021

Time (Duration) 9.30 am – 1.00 pm (3.5 hrs)

Module Cap 25 students



CEE/1

1 June 2021 (Tuesday)

Title

Dimensional Analysis in Hydraulics Engineering

Description

Dimensional Analysis (DA) is a fundamental method in hydraulics to collate experimental and field data into useful formulae for practical application. For example, the frictional resistance in water supply pipeline to household needs to be accounted for in design and it depends on many variables such as the size and shapes of pipe (circular, rectangular, triangular etc) , types of pipeline material (cast iron, steel, concrete, brass etc), and the fluid to be transported (water, oil etc). We will discuss how DA is applied to correlate the thousands of laboratory data available into a unifying trend called the Moody Diagram. We will also discuss interesting applications using DA in sediment transportation engineering (think in terms of how we compute quantity of sand particles movements in rivers) and erosion problems (think in terms of why bridges collapsed when subject to flood flow or how big is the scour hole when water jets shoot on a sand bed).

Lecturer

Assoc Prof Lim Siow Yong

Mode of Delivery

Lecture / Tutorial

College / School

College Of Engineering / School of Civil and Environmental Engineering

Date

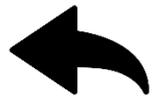
1 June 2021

Time (Duration)

2.00 pm – 5.30 pm (3.5 hrs)

Module Cap

20 students



SBS/1

2 June 2021 (Wednesday)

Title	Structural Biochemistry
Description	Biochemistry is the branch of science that seeks to describe the structure, organization, and functions of living matter in molecular terms. Biochemistry can be divided into three principal areas 1. Structural Biochemistry of the components of living matter and relationships of biological function to chemical structure 2. Metabolism, the totality of chemical reactions that occur in living matter. 3. Genetic Biochemistry, the chemistry of processes and substances that store and transmit biological information. In this module, I will deliver lectures and conduct computer based laboratory sessions explaining how structural biochemistry help us in understating molecular basis of living organisms and diseases. During the first half of the module, students will learn about fundamental principles of biomolecules chemistry, interactions and three-dimensional structures. In second half, students will be provided with structure based problems and they will analyze using computer applications.
Lecturer	Assoc Prof Surajit Bhattacharyya
Mode of Delivery	Lecture / Laboratory
College / School	College of Science / School of Biological Sciences
Date	2 June 2021
Time (Duration)	9.30am – 5.30pm (7 hrs)
Module Cap	25 students



CBC/1

3 June 2021 (Thursday)

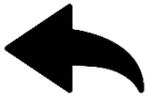
Title	Be a Molecular Detective for a Day – Theory and hands on experience on a benchtop NMR Spectrometer
Description	<p>Nuclear Magnetic Resonance (NMR) Spectroscopy (a cousin of the Magnetic Resonance aka MRI Imaging technique used in hospitals) is a very powerful and advanced method which allows scientists to understand the structure and purity of compounds. It is used extensively in scientific research in the fields of chemistry, materials science and biology as well as in medicine, and various industries.</p> <p>In this module, during the morning session you will be introduced to the basic theory behind NMR spectroscopy (only basic knowledge of atomic structure and a very preliminary understanding of types of simple molecules such as alcohols, amines, ethers and esters is required).</p> <p>During the afternoon hands-on session you will get to identify unknown compounds using the theory you have learned. You will get to use a new type of portable NMR spectrometer called a benchtop NMR and learn to acquire and interpret the data.</p>
Lecturer	Dr Sumod Pullarkat
Mode of Delivery	Lecture / Laboratory
College / School	College of Science / School of Physical and Mathematical Sciences
Date	3 June 2021
Time (Duration)	9.30 am – 5.30 pm (7 hrs)
Module Cap	20 students



MAE/1

4 June 2021 (Friday)

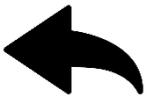
Title	Taking Inspiration from Nature in Building Tomorrow's World
Description	This is a fully interactive hands-on module. During this module, we will pick selected natural materials (such as seashells, plants, insects) and zoom in into their organisation. We will then discuss what are the key parameters that make these materials interesting, why they can be better than the materials our industry fabricate and what tools we can use to recreate them for our needs. The module aims at being interactive, with the handling of various samples, videos, and pictures and will include small group discussions. It is guaranteed that you will not look at Nature the same way after the module!
Lecturer	Asst Prof Hortense Le Ferrand
Mode of Delivery	Lecture / Hands-on Activities
College / School	College of Engineering / School of Mechanical and Aerospace Engineering
Date	4 June 2021
Time (Duration)	9.30 am – 1.00 pm (3.5 hrs)
Module Cap	15 students



MAS/1

4 June 2021 (Friday)

Title	Discrete Mathematics and Statistics with Applications
Description	Students will be introduced to intriguing mathematical concepts that appear in discrete mathematics and statistics, through a wealth of hands-on examples and problems. An introduction to some basic and some advanced topics in discrete mathematics, optimization and statistics through examples, hands-on problems, and computer experiments will also be given. Real world applications, in particular, of linear optimisation, game theory and statistics, will be discussed. The topics covered include: <ul style="list-style-type: none"> • mathematical game theory • matrix games • mathematical models for games and computation of optimal strategies • linear programming and applications • common misconceptions in statistics • statistics in virus detection • statistical paradoxes
Lecturer	Prof Bernhard Schmidt
Mode of Delivery	Lecture
College / School	College of Science / School of Physical and Mathematical Sciences
Date	4 June 2021
Time (Duration)	9.30 am – 1.00 pm (3.5 hrs)
Module Cap	24 students



MAS/2**4 June 2021 (Friday)****Title** Gems of Number Theory**Description** Two elementary topics from number theory will be covered: the Law of Quadratic Reciprocity; and the Frobenius Number. One interesting problem is that if a rectangle can be tiled with finitely many small rectangle all of which have at least one sides with integer length, then the big rectangle must have the same property. It sounds weird, however, it's true and mathematicians managed to give various proofs in different branches of mathematics, like number theory, complex analysis and geometry. So based on this famous problem, can we extend the relation between tiling problems and number theory? The only pre-requisite for this module is a passion for pure mathematics and the ability to appreciate beautiful proofs.**Lecturer** Dr Lim Kay Jin / Ms Wang Jialin**Mode of Delivery** Lecture**College / School** College of Science / School of Physical and Mathematical Sciences**Date** 4 June 2021**Time (Duration)** 2.00 pm – 5.30 pm (3.5 hrs)**Module Cap** 24 students