New Course Code and Title	**MS7140 Properties of Materials**
Course Coordinator	Dr Alfred Tok
Details of Course	**Summary of course content** *(please note that this information provided will also be uploaded to the web for viewing at large)* This course will cover mechanical, thermal, optical, magnetic and electric properties. The following topics will be studied. 1. Elastic, hardness, fracture, fatigue of materials. 2. Understand light interaction with solids and its effects on refraction, reflection, absorption, transmission and others. 3. Understand different sources of magnetic moments. Understand the nature and sources of different magnetic phenomena. 4. Understand the electron band structure for solid materials, charge storing capacity, ferroelectricity and piezoelectricity
	Rationale for introducing this course This course provides an overall perspective of the important materials properties, namely, mechanical, optical, magnetic and electrical properties. The concept of each of these properties and the characterization method will be introduced.
	Aims and objectives The aim of this course is to introduce central concepts in the properties of materials that will underpin the program. This will form a solid platform for engineers to launch into higher level courses that utilize material properties in designing structures, devices and systems. At the end of this course the students will be able to: 1. Choose standard experiments to measure specific properties. 2. Recommend materials for specific applications. 3. Explain the reasons for a material to exhibit certain properties and suggest methodology to improve them.
	Course Syllabus Please see below.

Assessment (Individual and group assessment)	2 x Continuous Assessment (Test) - Individual 1 x Essay (Instructor + Peer Marked) - Group 1 x Learning Log (Peer Marked) - Group	50% 30% 20%
	Total:	100%
To be offered with effect from (state Academic Year and Semester)	AY 2017-18 Semester 1	
Cross Listing (if applicable)	N.A.	
Prerequisites (if applicable)	N.A.	
Preclusions (if applicable)	N.A.	
Mode of Teaching & Learning (Lectures, regular tests, Q&A, problem-based learning)	Lectures, expert interviews, CA, tutorials, authentic texts, critical reviews, peer discussion	
Basic Reading List • **Compulsory Reading** • **Supplementary Reading**	Materials science and engineering, an introduction, William D. Callister, Jr. (2010) by Wiley Deformation and Fracture Mechanics of Engineering Materials, Richard W. Hertzberg, 1996, John Wiley Electronic Properties of Engineering Materials, James D. Livingstone, MITSeries in Materials Science & Engineering, 1999, John Wiley	
Maximum Class Size	50	
Hours of Contact/Academic Units	26 hours/2 AUs	
Workload Per Week (The workload for a 3 AU course must add up to 39 hours of contact hours)	Lecture hours per week Tutorial hours per week	2 hrs
	Total hours per week	2 hrs

Course Syllabus

The following topics will be covered:

MODULE 1: MATERIALS' MECHANICAL AND THERMAL PROPERTIES

1: Elastic properties of materials
Define engineering stress-strain diagrams and understand the limitation of different tensile, shear, torsional deformation testing.

2: Hardness
Understand the different definitions of microhardness and nanohardness. Cite situations for which these techniques are generally used. Be aware of the artefact in the nanoindetation measurement.

3: Fracture
The origin of fractures, especially in ceramics. Griffith criteria and its limitation. Microstructure control to enhance toughness.

4: Creep, subcritical crack growth and fatigue
The origin of creep and subcritical crack growth. The experimental details of measuring creep. The approaches to control creep, fatigue and subcritical crack growth.

5: Thermal heat capacity, thermal expansion and conductivity
The primary mechanism by which thermal energy is assimilated in solid materials. Determine the coefficient of thermal expansion using potential energy-versus-interatomic separation plot. The two principal mechanism of heat conduction in solids.

6: Thermal stress and thermal shock
The origin of thermal residual stress and thermal shock. Quantify thermal stress and thermal shock. Cracking issue related with thermal mismatch.

MODULE 2: MATERIALS' OPTICAL, MAGNETIC AND ELECTRICAL PROPERTIES

1: Optical properties of materials
Compute the energy of a photon, given its frequency. Electronic polarization from electromagnetic radiation-atomic interaction. Mechanism of photon absorption. Opacity induced by three sources of internal scattering. Construction and operation of ruby and semiconductor laser. The application of optical phenomena, such as luminescence and photoconductivity and optical fibers.

2: Magnetic properties of materials
Determine the magnetization of some materials, given susceptibility and the applied magnetic field strength. Difference sources of magnetic moments. Understand the nature and source of diamagnetism, paramagnetic, and ferromagnetism. Understand the source of ferrimagnetism from atomic and crystal structure. Understand magnetic hysteresis. Understand superconductivity.

3: Electrical properties of materials
Understand the electron band structure for solid materials, calculate the conductivity of metal, semiconductor and insulator, and understand the approaches to control it. Understand the capacitance and dielectric constant. Know how to enhance the charge storing capacity for a capacitor. Other important electrical properties, ferroelectricity and piezoelectricity.