<table>
<tr><td>New Course Code and Title</td><td colspan="3">MS7120 Inorganic Materials</td></tr>
<tr><td>Course Coordinator</td><td colspan="3">Dr Feng Xiaolei</td></tr>
<tr><td rowspan="3">Details of course</td><td colspan="3">Rationale for Introducing this course
The course presents a balanced treatment of descriptive inorganic chemistry that underpins the design and deployment of technological materials. The goal is to be comprehensive, while remaining understandable to students from diverse scientific and engineering backgrounds. This course begins by revising the construction of atoms and their properties, followed by a systematic analysis of reactivity, stability and properties. These concepts are illustrated with reference to important classes of industrial materials.</td></tr>
<tr><td colspan="3">Aims and Objective
The aim is to equip students to critically assess inorganic compounds, predict their properties based on chemistry, and design new materials with specific properties.

At the end of this course the students will be able to:
1. compare and correlate electromagnetic emissions with atomic structure.
2. explain how polarization, electron affinity and valency determine the relative contribution to bonding characteristics.
3. describe the characteristics and reactivity of common non-metals and metals.
4. list and analyse non-metal and metal technologies in engineering industry such as thermoelectric, superhard and chalcogenide materials.</td></tr>
<tr><td colspan="3">Course Syllabus
Refer to page 2 to 3</td></tr>
<tr><td rowspan="4">Assessment
(Individual Assessment)</td><td>Assessment Point</td><td colspan="2">3</td></tr>
<tr><td>Mode of Assessment and Weighting</td><td>2x Continuous Assessment (MCQ)
1x Essay (Peer Marked)</td><td>80%
20%</td></tr>
<tr><td></td><td>Instructions</td><td colspan="2"></td></tr>
<tr><td></td><td>Mapping of Assessment</td><td colspan="2">CA 1 – Modules 1 and 2
CA 2 – Module 3
Essay – Modules 1, 2 and 3.</td></tr>
<tr><td>To be offered with effect from
(state Academic Year and Semester)</td><td colspan="3">AY 2019-20, Semester 1</td></tr>
<tr><td>Cross Listing (if applicable)</td><td colspan="3">N/A</td></tr>
<tr><td>Prerequisites (if applicable)</td><td colspan="3">NIL</td></tr>
<tr><td>Mode of Teaching & Learning
(Lectures, regular tests, Q&A, problem-based learning)</td><td colspan="3">Lectures, MCQ, tutorials, authentic texts, peer discussion</td></tr>
<tr><td>Basic Reading List
Compulsory Reading –NIL
Supplementary Reading</td><td colspan="3">Supplementary Reading
1. Tilley, R. J. D. (2006). Crystals and Crystal Structures. Hoboken, NJ : John Wiley.
2. Shriver, D. (2006). Inorganic Chemistry Paperback. Oxford: Oxford University Press.</td></tr>
</table>

	3. Carter, C. B. and Norton M.G. (2013) *Ceramic Materials: Science and Engineering*. https://doi-org.ezlibproxy1.ntu.edu.sg/10.1007/978-1-4614-3523-5.
Hours of Contact/Academic Units	39 hours/ 3 AUs

Course Syllabus

The following topics will be covered:

MODULE 1: FUNDAMENTAL PROPERTIES AND PRINCIPLES

1.1: The Atom

The integral progression of the atomic number Z and the Bohr's model.

1.2: The Electronic Structure

Quantization of electron energy, quantum numbers and electronic configuration, "Aufbau" principle, ionization end electron affinity of atoms

1.3: Covalent Bonding

Lewis structure, octet rule, molecular orbital theory, sigma and pi bonds, orbital hybridization

1.4: Ionic Bonding

Electro-negativity and its nature in determining ionic bonding, example of ionic bonds, mixed ionic-covalent character

1.5: Spectroscopic Energies

Electromagnetic spectrum, emission and absorption spectra, hydrogen spectrum as an example

1.6: Atomic Radius

Concepts of atomic/ionic radii and theories of deriving the radii.

1.7: Bonding Types in Solids

Types of bonding found in solids with examples and general properties: ionic, covalent, metallic, hydrogen and Van der Waals

1.8: Chemical Reactions and Valency

The representation of valence, oxidation state, and ideal and general chemical formula. Practice in writing and balancing chemical formula and reactions.

MODULE 2: NON-METALLIC MATERIALS

2.1: Halogens

Introduction to properties of halogens, metal halides. Occurrence and uses of halogens and their compounds.

2.2: Oxygen Group

Chemistry and occurrence of sulphur, selenium and tellurium. Important sulphides and oxides

2.3: Nitrogen Group

Synthesis and properties of nitrides, phosphides, arsenides, and antimonides.

2.4: Carbon

Carbon allotropes: diamond, graphite, fullerene, graphene, carbon nanotubes; their structure, properties, occurrence and uses. Properties and chemistry of industrially relevant carbides and their synthesis.

2.5: Silicon and Silicates

The metalloid family. Elemental silicon: chemistry, occurrence, properties and uses. Structure chemistry of silicates, silica and alumino-silicates.

2.6: Boron and its Compounds

Occurrence, chemistry and uses of boron, borates and borides.

2.7: Chalcogenide Materials

Structure and chemistry of chalcogenides, specific applications: thermoelectric materials derived from bismuth chalcogenides, photovoltaic materials, uses in special glasses

2.8: Superhard Materials

The chemistry and performance of diamond, carbon nitride and cubic boron nitride and boron carbide

MODULE 3: METALLIC MATERIALS

3.1: Alkaline and Alkaline Earth Metals and Compounds

Chemistry, occurrence and uses of these metals. Extraction of magnesium. Industrially relevant compounds such as oxides, carbonates

3.2: Aluminium, Gallium and Indium and Compounds

Chemistry, occurrence and uses of these metals. Extraction of aluminium from bauxite. Industrially relevant alloys and compounds; their properties and uses.

3.3: Transition Metals and Compounds (Excluding Iron)

Chemistry, occurrence extraction and properties of transition metals. Special alloys such as brasses, bronzes, nimonics and alnico alloys

3.4: Rare Earth Metals

Chemistry, occurrence and uses of rare earth metals. The systematics of oxides, sesquioxides.

3.5: Lanthanide Oxide Glasses

Preparation and performance lanthanide oxide optical glasses.

3.6: Iron and Steel

Iron extraction; the blast furnace reactions. Steel making.

3.7: Special Steel Grades

Property manipulations in steels: heat treatments and phases in steels. High speed tool steel. stainless steel. Cast iron.