**New Course Code and Title**  
MS7120 Inorganic Materials

**Course Coordinator**  
Dr Feng Xiaolei

**Details of course**

**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.

**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.

**Course Syllabus**
Refer to page 2 to 3

**Assessment**

<table>
<thead>
<tr>
<th>Assessment (Individual Assessment)</th>
<th>Assessment Point</th>
<th>Mode of Assessment and Weighting</th>
<th>Instructions</th>
<th>Mapping of Assessment</th>
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<tbody>
<tr>
<td></td>
<td>3</td>
<td>2x Continuous Assessment (MCQ)</td>
<td></td>
<td>CA 1 – Modules 1 and 2</td>
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<td>1x Essay (Peer Marked)</td>
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<td>CA 2 – Module 3</td>
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<td>Essay – Modules 1, 2 and 3.</td>
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**To be offered with effect from**  
( state Academic Year and Semester)

AY 2019-20, Semester 1

**Cross Listing** (if applicable)
N/A

**Prerequisites** (if applicable)
NIL

**Mode of Teaching & Learning**
(Lectures, regular tests, Q&A, problem-based learning)

Lectures, MCQ, tutorials, authentic texts, peer discussion

**Basic Reading List**

<table>
<thead>
<tr>
<th>Compulsory Reading</th>
<th>NIL</th>
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</table>
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

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<tr>
<th>Hours of Contact/Academic Units</th>
<th>39 hours/ 3 AUs</th>
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</table>

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