

## **Introduction to Nanotechnology (ENGG 212)**

**Credit Hours:** 3

**Course Pre-Requisites:** Not Applicable

**Instructor:** Salman Noshear Arshad

**Schedule:** 3.30 PM – 5.30 PM

**Course Description:** Nanotechnology is all about materials that are significantly smaller than a human eye can see. To put this into perspective, 1 nanometer is 1 billionth of a meter ( $1\text{ nm} = 10^{-9}\text{ m}$ ) and a human hair is typically 80,000 – 100,000 nm thick. Such small materials can be formed by scaling down from bulk/microscale to nanoscale dimensions or can be grown atom by atom. The characteristics of materials can potentially change when their dimensions are reduced to nanoscale and in this regime their properties can also be tuned. For example, color of the same material, e.g. gold, at nanoscale can be controlled by their size! Moreover, electrical, magnetic, mechanical and other properties can be altered and enhanced which opens up new avenues of their potential widespread use. This course will provide an overview of nanotechnology and demonstrate why nanoscale regime is different from microscale and bulk regime which results in unique properties. Applications of nanotechnology will be discussed including the very first known use of nanoscale gold and silver in the 4th century Lycurgus Cup, use of metallic nanoparticles in the medieval Islamic pottery, and stained-glass windows. Modern era applications in electronics, sports, medicine, textiles, energy and environment will also be discussed e.g. light-weight automobile bumpers, golf balls and tennis rackets, sunscreens, faster recharging batteries for handheld devices, and digital displays. The famous “Moore’s law”, predicted by the Intel co-founder Gordon Moore in 1965, will be discussed which is still valid but is it approaching the ultimate limit? These applications are driven by the discovery and synthesis of a diverse range of nanomaterials, development of fabrication technologies capable of producing such materials at small scale, development of tools which can see such small materials and manipulate them as seen in the World’s Smallest Movie by IBM. The course is multidisciplinary in nature and will primarily attract science and engineering students and

will include 2-3 short guest lectures from experts in a relevant field of nanoscience and nanotechnology