# Short Course Description

**Course Title**
Quantum Dots: Materials, Physics, and Devices

**Course Description**
The term nanotechnology is mentioned almost every day in the popular media and has permeated the commercial world ranging from consumer electronics to fabrics and prescription drugs. In the technical community, nanotechnology is a broad term and ranges from next generation integrated circuit technology to carbon nanotubes. In this course, we address nanotechnology – specifically quantum dots – in the context of compound semiconductor materials and devices and, in particular, those applications in the area of photonics.

The course addresses the implications of nanostructures in terms of the semiconductor physics of reduced dimensionality – the effects of reducing the physical size of a structure through growth or processing to the quantum regime (<50 nm) in one, two, or three dimensions. We connect these effects with the characteristics of semiconductor electronic and photonic devices, such as laser threshold and spectral properties, to show the driving forces for exploring the area. We present a visual description of the methods for forming quantum dots and wires and describe the science of strained materials behind them that allows the formation of these novel materials. Finally, we outline the state-of-the-art for quantum dot photonic devices and give some idea of the extent to which the promise of these novel structures is fulfilled.

**Benefits and Learning Objectives**

This course should enable participants to:

Explain the effects of reduced dimensionality on fundamental semiconductor properties

Compare these effects with conventional bulk and quantum well materials

Outline the specific impact of reduced dimensionality on the optical properties important for diode lasers

Define the growth mechanisms for strain-driven self-assembled quantum dots

Contrast the advantages and disadvantages of self-assembled and patterned quantum dots

Summarize the state of the art for compound semiconductor quantum dot lasers and optoelectronic devices

**Intended Audience**

This course is designed for researchers, engineers, and managers who wish to gain some insight into the emerging technology of quantum dots, and semiconductor nanostructures in particular. The course content is targeted at anyone with an undergraduate background in electrical engineering, physics, chemistry or materials science or some background and interest in semiconductor physics, electronics or materials growth.

**Instructor Biography**

James J. Coleman holds the Intel Alumni Endowed Chair in Electrical and Computer Engineering at the University of Illinois. He was previously at Bell Laboratories and Rockwell International. He and his students are involved in the study of quantum dots, quantum well heterostructures, and low threshold and high power diode lasers. Professor Coleman received the OSA Nick Holonyak, Jr. Award, the ISCS Heinrich Welker Award, the IEEE LEOS William Streifer Scientific Achievement Award, and was an IEEE LEOS Distinguished Lecturer. He is a Fellow of the IEEE, OSA, APS, and AAAS.