KU Engineering High School Summer Camps
Summer 2017

Course Descriptions and Lead Instructors

Aerospace Engineering

Course Description
The week starts with an introduction to aerospace engineering and its applications. Then we continue with the subject of how airplanes fly. The forces and moments acting on an airplane in flight namely, lift, drag, weight, thrust, pitching moment, rolling moment, and yawing moment are explained and demonstrated. The control surfaces of aircraft such as, aileron, elevator, rudder, as well as flaps and trim tabs will also be covered. The basics of helicopter flight will follow the purpose of the main and tail rotors, as well as the collective and cyclic pitch controls are explained. These subjects are clarified by the use of in-class video tapes, model airplane demonstrations, wind tunnel testing, etc. Then, the aerospace engines will be covered. In this part, the principle of operation of aircraft piston engines, jet engines, and rocket engines will be covered. Engine models, video tapes, engine animations, and engine simulators are used to support the lectures. Finally the supersonic flight, shock waves and sonic boom are covered. The morning lectures are supplemented by afternoon’s laboratory sessions of wind tunnel testing, water tunnel testing, running the jet engine simulator, flying the aircraft simulator, and finally a visit to our flight test facilities at Lawrence Airport and observing operational drones, airplanes, etc.

Lead Instructor
Professor Ray Taghavi earned his PhD in Aerospace Engineering from The University of Kansas in 1988. Prior to joining the KU faculty, he was a Research Engineer at NASA John Glenn Research Center from 1986-1991. Dr. Taghavi has been teaching at KU in the Aerospace Engineering Department in the School of Engineering since 1991, specializing in Aerospace Propulsion, Vehicle Aerodynamics, and Fluid Mechanics. Dr. Taghavi’s research areas are, Aerospace Propulsion, Aircraft Aerodynamics and Control, Fluid Mechanics, and Wind Tunnel Testing. Current projects that Dr. Taghavi is working on include innovative velocity measurement techniques for Unpiloted Aerial Vehicles, Jet Engine Noise Reduction Techniques, Wind Turbines, etc.

Architectural & Civil Engineering

Course Description
Civil and Architectural Engineering have their roots in the oldest works of humankind and cover a wide variety of engineering challenges, ranging from buildings and bridges to highways, dams, water systems, energy and traffic management, and protecting the environment. In this course we will explore these topics and more as we plan projects, build structures, visit operating
engineering structures, and learn how engineers design engineering works that function well for the modern world.

**Lead Instructor**

*Dr. Bob Parsons is a Professor in the Civil, Environmental, and Architectural Engineering Department at the University of Kansas. He came to KU in 1998 after finishing his PhD in Civil Engineering at the Georgia Institute of Technology. In addition to teaching at the graduate and undergraduate level, Dr. Parsons has an active research program with emphases on soil stabilization, aggregate testing, deep foundations, mechanically stabilized earth, and railroad ballast characterization and improvement. He is an author of dozens of publications for many research journals, conference proceedings and technical reports. He is the current Chair of the Committee on Cementitious Stabilization for the Transportation Research Board (a part of the National Academies of Sciences, Engineering, and Medicine). Dr. Parsons has also served as Director of Construction for the School of Engineering at KU since 2014, where he represented the School on 80 million dollars of new construction that included two new buildings and renovation of the Engineering Library, in addition to ongoing renovation activities.*

**Bioengineering**

**Course Description**

The Bioengineering course track is experiment based camp, and one where students will perform hands-on experiments. While completing these experiments students will be introduced to medical device design, bio materials and tissue engineering, and biomechanical engineering. No prior knowledge in these topics is required.

**Lead Instructor**

*Dr. Maletsky began teaching at the University of Kansas in 2000. His courses are in the design and mechanics tracks of the curriculum, and he also offers graduate courses in dynamics and manufacturing. He has received a number of teaching awards including the Kemper Fellowship for Teaching Excellence and the Sharp Teaching Fellowship. Dr. Maletsky’s research area is machine design and biomechanics, specifically the experimental testing of cadaveric joints using custom-designed physiological loading equipment. He has had funding from the orthopedic industry, the National Science Foundation, and the Center for Disease Control. Graduates from his laboratory hold positions in a number of the world’s largest orthopedic companies, as well as in academia and in other industries. He is a member of the Bioengineering Division of ASME and currently chairs the Design, Dynamics, and Rehabilitation Technical Committee. Dr. Maletsky is also a member of the Orthopedic Research Society and the American Society for Engineering Education.*

**Electrical Engineering**

**Course Description**
The Electrical Engineering (EE) summer camp is a week-long, project based, camp where the students will learn to construct both analog electronic circuits and digital electronic circuits on breadboards provided by the Instructor. Circuits under consideration will include amplifier or filter circuits using music (WAV) files as inputs under the Analog Domain as well as circuits such as binary half/full adder and 3-bit binary counter under the Digital Domain. As both analog circuit design and digital circuit design forms the bedrock of Electrical Engineering, students will be taught on the building blocks for designing these circuits via lectures as well as hands-on project experiences. In addition, students will also be exposed to Computer-Aided-Design (CAD) tools such as PSpice and VHDL design and simulation languages to verify the output from their circuits constructed on breadboards. Finally, no prior electrical engineering knowledge is required from the students.

**Lead Instructor**

Mr. Peng Seng “Isaac” Tan will earn his PhD in Electrical Engineering before the end of Spring 2017 from the University of Kansas. Since January 2014, Mr. Tan has been teaching at KU as a Graduate Teaching Assistant in the Electrical Engineering and Computer Science department from the School of Engineering on both Circuits and Electronics lab and Embedded Systems Programming lab for mainly juniors and seniors. Mr. Tan’s current dissertation research areas are involved in addressing RF Spectrum Congestion challenges (as a result of proliferation of smart mobile devices and Internet of Things) via the approach of Spectrally-Cooperative Radar Design. In addition, prior to the pursuit of his PhD degree in KU, he was working as a Senior Member of Technical Staff (SMTS) in DSO National Laboratories based in Singapore working on digital signal and image processing for radar, hyperspectral, infrared and electro-optics systems.

**Chemical Engineering**

**Course Description**

The Chemical and Petroleum Engineering (C&PE) course track is experiment based camp, and one where students will perform hands-on experiments. While completing these experiments students will be introduced to the fundamentals of chemical and petroleum engineering including reaction engineering, catalysis, thermodynamics, polymer science, and reservoir engineering. No prior knowledge in these topics is required.

**Lead Instructor**

Three instructors will be leading the summer camp, all of them affiliated with the Department of Chemical and Petroleum Engineering at:

- Professor Juan J. Bravo Suarez, Catalysis and in situ spectroscopy research group
- Professor Reza Barati, Unconventional resources laboratory
- Dr. David Griffin, Unit operations laboratory professor

**Computer Science**
Course Description
The purpose of this course is to introduce the student to the field of Computer Science. Students will work with each other and the instructor to develop and understand the essential concepts of Computer Science through group work and project based learning. The student will learn algorithm development, basic computer organization, syntax and semantics of a high-level programming language, including testing and debugging. The students will use the concepts of structure in data and programs, top-down design, subroutines, and library programs to develop a working computer program.

Lead Instructor
Professor David O. Johnson earned his PhD in 2009 from the University of Kansas. Dr. Johnson has been teaching Electrical Engineering and Computer Science courses at KU and the University of Missouri – Kansas City since 2009. Dr. Johnson’s research areas are human–robot interaction and natural language processing. He held two post-doctoral research positions, one at the University of Technology in Eindhoven, the Netherlands where he worked on human–robot interaction; and one at Northern Arizona University where he developed natural language processing software for applied linguistics. Prior to earning his PhD, Dr. Johnson worked in industry for 31 years.

Mechanical Engineering

Course Description
The purpose of this course is to introduce the student to the field of mechanical engineering through an exploration of its core areas including mechanics, kinematics, thermodynamics, material science, structural analysis, and electronics. By using principles and methods of design and analysis, students will be engaged through group work and project based learning in both research and teaching laboratories. For example, each afternoon the students will work in small groups using active learning to develop an understanding of: 1) concepts in computer programming, 2) the use of sensors and logic used in controls, 3) the design and development of small scale robots, and 4) strategies used to compete in daily design competitions. The student will be encouraged to think creatively throughout.

Lead Instructor
Professor Carl W. Luchies earned his PhD in Mechanical Engineering from the University of Michigan. Dr. Luchies has been teaching at KU in the Mechanical Engineering department in the School of Engineering since 1996, specializing in measurements, experimentation, biomechanics, dynamics, computational modeling and signal processing. Dr. Luchies is the director of the Biodynamics Research Laboratory, which focuses on the biomechanics and motor control of human movement. Current projects that Dr. Luchies is working on include the application mechanical engineering techniques to the analysis of the biomechanics and motor control of human movement which can be used to detect postural instability (i.e. high fall risk) in older adults with neuromuscular diseases (e.g. stroke, Parkinson’s disease, multiple sclerosis, etc.).