PROFESSIONAL DEVELOPMENT COURSES

This year, a variety of strong Professional Development Courses will be offered, providing a great learning opportunity from renowned industry experts. IWCS will present the annual core courses of Copper 101, Fiber 101, Materials 101 and Extrusion 101. The four core courses will provide those new to our cable & connectivity industry with basic technology information. The four elective courses will deliver current, leading edge topics geared at providing information on new areas of interest to engineers, scientists, and other cable & connectivity professionals. Over time, students completing those courses, along with two electives, will be presented with an IWCS Professional Development achievement plaque.

The Professional Development Courses will commence on Sunday, September 29 at 1:00 PM with four concurrent sessions. Four more concurrent sessions will continue at 8:00AM Monday, October 1. The Courses will conclude prior to the Plenary Session and Technical Symposium Sessions 2-15, allowing attendees to participate both in the Courses and the Symposium.

SUNDAY, September 29TH, 2019 – 1:00 PM – 5:00 PM

CORE COURSES

CU101: Fundamentals of Copper Conductors & Metallic Cable Design & Applications  
FO101: Fundamentals of Optical Fibers & FO Cable Design & Application  
MA101: Selection & Use of Materials in Wire & Cable  
EX101: The Art and Science of Extrusion Machinery for Wire and Cable

MONDAY, September 30, 2019 – 8:00 AM – 12:00 PM

ELECTIVE COURSES

MA210: Fluoropolymers: An Introduction and Guide to Selecting Materials for Wire and Cable as well as Processing Guidelines  
FO211: Fiber and Connectivity for Data Centers  
CU207: Fundamentals of Signal Integrity  
CU208: Copper Cabling Technology – Measurement Technology for Existing and New Applications
COURSE DESCRIPTIONS
Sunday, September 29TH, 2019 – 1:00 PM – 5:00 PM
CORE COURSES

CU101: Fundamentals of Copper Conductors & Metallic Cable Design & Applications

Instructors:
Trent Hayes, Engineering Director, CommScope Incorporated, Claremont, NC, USA
Larry Bleich, Engineering Director, CommScope Incorporated, Catawba, NC, USA

Description:
This course is an introduction to the design and application of copper conductor communications cables. Students will understand how coaxial, twisted pair and twin axial cables are designed and how they operate upon completing the class. The instructors will provide background material on the history of copper cabling followed by sections on applications, design and construction of cables. Current standards and design examples are also reviewed by the instructors. Materials that are typically used in copper conductor communication cables will be incorporated at a fairly high level into the design exercises.

Industry professionals desiring a basic knowledge of copper cabling systems will find the course of value.

FO101: Fundamentals of Optical Fibers & FO Cable Design & Application

Instructor: David A. Seddon, Senior Engineering Associate, Cable Technology, Corning Optical Communications, Hickory, NC, USA

Description:
This course will explore several aspects of optical fiber and cable design technology with particular focus on products for communications. It will discuss application considerations to select a product appropriate for a given installation environment and the basic considerations necessary for successful design of optical fiber cables.

The first part of this course will outline the characteristics and fundamental operating principles of optical fibers and the key differences between Single-Mode and Multimode optical fibers. Included will be critical fiber parameters and their impact on system performance. Specific topics will include the Advantages of Optical Fiber, Optical Fiber Manufacturing, Total Internal Reflection, Attenuation, Dispersion, Polarization Mode Dispersion (PMD), Cutoff Wavelength and other optical parameters critical to optical communications.
The second part of this course will explore the functional requirements of optical fiber cables and some of the fundamental design equations which can be used to ensure a cable will meet a given installation or operational requirement. The course will also discuss selection of a product appropriate for a given installation environment. Structural differences between cables for indoor, outdoor, and specialty applications will be explored including stranded loose tube cables, central and stranded tube ribbon cables, tight buffered cables and optical power ground wire cables.

The course provides a basic overview of optical fiber fundamentals and optical cable design principles to those new to the fiber optic cables.

**MA101: Selection & Use of Materials in Wire & Cable**

**Instructor:** Dr. Scott Wasserman, Associate R&D Director/ICM, The Dow Chemical Company, Collegeville, PA, USA

**Description:**

In this course, the selection and implementation of polymer materials used in the construction of wires and cables will be reviewed. The course will focus on polymer materials utilized in telecommunication cable applications with focus on twisted pair, coaxial, and fiber optic cables. An overview of the materials science essential to the polymer properties and additives employed in cable compounds will be covered to level-set all attendees. Further, the fundamental characteristics (advantages and disadvantages) of materials will be presented which can be then considered in selecting a material for use in a finished cable construction, with specific sections covering jackets, insulations and fiber optic materials. In addition, the effect of additives on material performance will also be discussed, particularly those that impart ultraviolet resistant and flame retardant properties on the materials.

The course is intended for all wire and cable practitioners including raw material suppliers, cable manufacturers, and end users interested in gaining a broad understanding of applied material selection as it relates to cable performance.

**EX101: The Art and Science of Extrusion Machinery for Wire and Cable**

**Instructor:** Dr. Stéphan Puissant, Process Manager, Maillefer SA, Switzerland

**Description:**

The complete extrusion process is complex and involves a lot of machines having each a different function. The heart of the process being extrusion, we focus in this course on the extrusion group, i.e. extruder and cross head (distributor and tooling).
The single screw extruder seems to be a very simple machine. However, the extrusion process is complex as it is governed by interacting laws from different mechanical engineering fields i.e., thermodynamics, flow mechanics, properties of solid and molten polymers etc. Therefore, in a first step, the physical characteristics (viscosity, conductivity, melting) of polymers used in extrusion are presented. These properties will be the keys to understand the functioning of the thermoplastics extrusion process.

The material basis being covered, the focus will shift on the functioning of the single screw extruder. There the 3 functional zones of the extruder are introduced. For each zone, we will see its functioning in relation to material properties. This mechanism having been described, we will obtain some hints of the optimal screw designs (for some broader plastic families!), so as solutions which may be used to solve problematic issues.

After being plastified (molten), the polymer will be formed in its final shape by some extrusion head. In this part of the course, the basics of distributor design according to the materials are presented. After discussing the effects of distributor geometries, we will also compare different tool designs. And the influence of temperature settings on concentricity, adhesion and surface quality will be shown.

For each of the different items (extruder, X-head, even cooling) evoked in the course, we will try to give some practical hints in relation with a more theoretical approach.

This course is intended for people involved in extrusion and who want a basic analysis tool for identifying potential machinery bottlenecks due to the extrusion group, so as to solve some issues which are hampering the productivity and quality.

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**MONDAY, September 30, 2019 – 8:00 AM –12:00 PM**

**ELECTIVE COURSES**

**MA210: Fluoropolymers: An Introduction and Guide to Selecting Materials for Wire and Cable as well as Processing Guidelines**

**Instructors:** Lensey H. Smith, PhD, Sr. Applications Scientist, Daikin America, Inc., Decatur, AL, USA  
Kohei (Kolby) Yasudaj, Senior Chemist, Daikin America, Inc., Decatur, AL, USA

**Description:**
This is an introductory course on fluoropolymers, selection, and use in the wire and cable industry. The participants will gain knowledge on the types of fluoropolymers available today for a variety of wire applications including primary insulation and jacketing for areas including telecommunications and co-axial. The course will provide a comparative analysis of properties to assist in making informed decisions on the
selection of the right fluoropolymer for the participants’ application. The final portion of the course will review the processing of fluoropolymers including safety, handling, and troubleshooting during the extrusion process.

This course will be useful for all professionals utilizing fluoropolymers in the wire and cable industry. It is also beneficial to those working in material procurement who are seeking further knowledge with respect to raw materials.

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**FO211: Fiber and Connectivity for Data Centers**

**Instructors:** Scott Bickham, PhD, Development Fellow, Corning Optical Communications LLC, Elmira, NY, USA

**Description:**
This course will begin with a brief review of the fundamentals of optical fiber and cables presented in the prerequisite FO101 course. This material will be followed by a more in-depth discussion of macrobending in optical fibers and how it can be mitigated through fiber design. The different categories of G.657 single-mode fibers will be delineated based on their bend performance and applications. The next section will focus on the design and applications of bend-improved multimode fibers, which have enabled significant reductions in the sizes of the cables, hardware and equipment that are deployed in data centers. The remainder of the course will focus on the cabling and connectivity infrastructures that address the challenges of reliability, manageability, scalability and flexibility in data centers. The material presented will include an overview of the cable and connectivity options that are available or are being developed for multifiber parallel interfaces and high bandwidth density.

This course is designed for industry professionals who are interested or involved in the selection of fiber types and connectivity solutions for data center and enterprise applications.

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**CU207: Fundamentals of Signal Integrity**

**Instructors:** Alistair Duffy, Faculty of Technology, De Montfort University, Leicester, United Kingdom
Kenneth Cornelison, Wire & Cable Technology Resources, Cincinnati, OH, USA

**Description:**
The high signaling and clock frequencies used in communications systems means that there are more sources of noise and distortion for modern electronics engineers to consider as part of their circuit design or measurement protocols. This course provides an introduction to Signal Integrity with a focus on the cable / connectivity industry.

The indicative content is:

- Time and frequency: bandwidth and spectra
- Shannon’s law, the evolution of coding schemes and inherent noise sensitivity
- Real components: understanding resistance, inductance and capacitance. Impedance and resonance

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• Single ended and differential signaling: differential and common mode
• Ground and power planes are not perfect: switching noise, ground bounce
• Transmission lines in time and frequency. Lossy and lossless. Reflections, dispersion, eye diagrams, jitter, time domain reflectometry
• Crosstalk: Inductive and capacitive coupling
• Scattering parameters and de-embedding
• Vias
• Understanding limitations of measuring equipment (rise times and bandwidth of scopes, loading of probes, etc.)
• Application impact. Techniques used to manage the impact of noise in communications systems.

This course is suitable as a refresher for experienced professionals, but mostly as an essential overview for engineers within the first few years of working in this field and who want to develop an understanding of the essentials of Signal Integrity.

CU208: Copper Cabling Technology – Measurement Technology for Existing and New Applications

Instructors: Peter Fischer, R&D Project Manager/ Product Line Manager, AESA Cortaillod, Colombier, Switzerland
Bernhard Mund, EMC Test Engineering and Standardisation, bda Connectivity GmbH, Asslar, Germany

Description:
This course explains the electrical parameters which have to be tested, starting from Cat5e to the latest cable standards such as Cat8 (Cat8.1/Cat8.2). An outlook is given towards the new standardisation projects concerning 1 pair applications.
In the second part of this course all EMC parameters and methods are presented. Transfer impedance, screening attenuation and coupling attenuation will be explained. For 1 pair applications new tests like low frequency coupling attenuation and triaxial methods for unscreened cables were developed and will be compared to the existing methods.

This session will help to understand the challenges for existing & new cable types and the best methods to test them.