COURSE OVERVIEW LE0160
Gas Chromatography Operation, Application, Troubleshooting & Method Validation

Course Title
Gas Chromatography Operation, Application, Troubleshooting & Method Validation

Course Date/Venue
Session 1: January 19-23, 2025/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
Session 2: June 15-19, 2025/Al Khobar Meeting Room, Hilton Garden Inn, Al Khobar, KSA

Course Reference
LE0160

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Description

This practical and highly-interactive course includes practical sessions and exercises where participants will visit the laboratory and they will be introduced to various lab instruments and gas chromatography process. Practical sessions will be performed using one of the lab equipment in order to apply the theory learnt in the class.

The use of Gas Chromatography plays a key role in the modern industry, not only by supplying effective data of known quality, but also providing these data in real-time or near real-time.

This course is offering everything the professional and the novice need to know about running, maintaining, and interpreting the results from Gas Chromatography. Analytical chemists, technicians, and scientists in allied disciplines will regard this course as the best in gas chromatography. In addition to serving as an invaluable update for the experienced practitioner, this course provides the beginner with a solid understanding of gas chromatographic theory and basic techniques.

This **state-of-the-art course** incorporates the **most recent developments** in the field of Gas Chromatography, including topics on optimization of separations and computer assistance; high speed or fast gas chromatography; mobile phase requirements: gas system requirements and sample preparation techniques; qualitative and quantitative analysis by Gas Chromatography; updated information on detectors; validation and QA/QC of chromatographic methods; and useful hints for troubleshooting gas chromatographs.

The fourth day of the course will be a **practical/hands-on demonstration workshop in our Laboratory** where **participants will familiarize themselves with instruments**, **analyse sample mixtures** and **develop their own GC method by themselves** with the guidance of the Course Instructor. In this way, the participants will get the benefits of using the course instruction in an **applied situation to develop their own GC method**. Further, participants will analyse the process, make adjustments and control the instrument, which will give them the most benefit from this course.

This course presents a well-rounded and comprehensive overview of the current state of this important technology, providing an invaluable knowledge that will greatly appeal to both experienced chromatographers and novices.

The course manual is a very comprehensive and contains many special topics that cover modern applications of GC in numerous disciplines. It is a must-have reference on the shelves of all laboratories doing gas chromatographic analyses.

Course Objectives

Upon the successful completion of this course, each participant will be able to: -

- Apply systematic techniques on operation, application, troubleshooting and method validation of gas chromatography
- Carryout sampling, sample handling and sample preparation
- Differentiate between packed columns & capillary columns as well as carryout chromatographic processes and component separation
- Discuss the general considerations when selecting capillary columns
- Describe gas chromatographic separation effects, carryout column selection, installation and use
- Carryout sample injection, discuss the general considerations, factors effecting injection, and types of injection methods
- Identify different types of GC detectors such as thermal conductivity detectors, flame ionization, electron capture, thermionic, photoionization, flame photometric and chemiluminescent detectors
- Discuss in detail the components and functions of gas chromatography-mass spectrometry (GC/MS)
- Carryout GC validation methods, troubleshooting and applications

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

This course provides an overview of all significant aspects and considerations of gas chromatography for those who need to run, operate, apply, troubleshoot, maintain and interpret the results from gas chromatography. Analytical chemists, scientists and other technical staff in allied disciplines will regard this course as the best in gas chromatography. In addition to serving as an invaluable update for the experienced practitioners, this course provides the beginners with a solid understanding of gas chromatographic theory and basic techniques.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

British Accreditation Council (BAC)

Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

- The International Accreditors for Continuing Education and Training (IACET - USA)

Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

Course Fee

US$ 5,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. **Nikolas Karnavos**, MSc, BSc, is a **Senior Analytical Chemist** with over **35 years** of extensive experience within the **Oil**, **Gas**, **Refinery** and **Petrochemical** industries. His expertise widely covers **Gas & Liquid Chromatograph Process Analysers**, **Process Analyzer Techniques** (**Online** & **Offline**), Laboratory Information Management System (**LIMS**), **Data & Method Validation in Analytical Laboratories**, Laboratory **Automation Techniques**, **Practical Problem Solving in Chemical Analysis**, **Practical Statistical Analysis of Lab Data**, **Chemical Laboratory**, **Analytical Laboratory & Instrumentation**, Laboratory **Health & Safety**, **GLP**, Laboratory **Quality Management** (**ISO 17025**), **ISO 9001** and Medical Laboratory Quality Management (**ISO 15189**). Further, he is also well-versed in Environmental **Online Analyzers** (**Air** & **Water**), **Gas Chromatography** and various instrumental methods of analysis such as **Water Analysis & Quality Control**, **Water and Wastewater Chemical** Analysis, **Statistical Data and Laboratory Analysis**, **Gas** Analysis, **Qualitative Fuel** Analysis, **Environmental Chemical** Analysis, **Laboratory Environmental** Analysis including Water Quality Testing, Process Water and **Wastewater Effluents**, Oily **Sludge Treatment**, Atomic Absorption and Spectroscopic Methods in Analytical Chemistry, **Analytical Method Development** and **Methods of Environmental Measurements** (**Water**, **Air**, **Liquid** & **Solid Wastes**).

Mr. Karnavos was the **Laboratory Manager** of **Exxon** wherein he was responsible for **ISO 17025 certification**, upgrading laboratory equipment in **refinery**, **petrochemical** and **polypropylene** plants, upgrading and extending LIMS, handling the transition plan process of the existing laboratory to a new as well as formulating and executing the plans for applied research and technology transfer. During his career life, he had occupied several significant positions as the **Laboratory Analyst**, **Laboratory Professor**, **Quality Manager**, **Partner & Managing Director**, **Environmental Engineer**, **Process Engineer**, **Environmental Management Corporate Department Head** and **Quality Control & Plastics Application Head** with different international companies like the **AQUACHEM**, **Hellenic Petroleum** (**EXXON**) and **Technological Institute**.

Mr. Karnavos holds a **Master's** degree in **Chemical Engineering** and a **Bachelor's** degree in **Mechanical Engineering** and **Petroleum Engineering** from the **Aristotelian University of Thessaloniki**, **Technological Institute** and **KATEE Kavala** respectively. He is an **Accredited Trainer** for the Organization for the Certifications & Vocational Guidance (**EOPPEP**), a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**), a **Certified Instructor/Trainer** and an **Accredited Environmental Auditor** from the **IEMA**. Further, he is the **President** of Greek **Association of Chemical Engineers** and an active member of various professional engineering bodies internationally like the **IEMA**, **Technical Chamber** of Greece and the **CONCAWE**. He also **published numerous books** and **scientific papers** and delivered various trainings and workshops worldwide.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Sampling & Sample Handling*** *Representative Sampling ● Effect of Sampling Error on Overall Precision ● Sample Contamination and Preservation ● Transmittal of Samples to Laboratory and Sample Receiving ● Disposal of Completed Samples ● Reporting of Data and Sample Accountability*
0930 – 0945	*Break*
0945 – 1100	***Sample Preparation*** *Sample Requirements for Gases, Liquids and Solid Samples ● Sample Clean Up, Solvent Extraction, Soxhlet Extraction, Solid Phase Extraction, Solid Phase Micro Extraction ● Sample Derivatization, Improved Volatility and Separation, Improved Sensitivity and Selectivity*
1100 – 1215	***Packed & Capillary Columns*** *Packed vs Capillary Columns ● The Chromatographic Process and Component Separation ● Effects of Carrier Gas Velocity ● Capillary Tubing ● Sources of Activity and Structural Flaws ● Silanol Deactivation ● Column Coating*
1215 – 1230	*Break*
1230 – 1420	***Capillary Columns*** *Stationary Phase General Considerations ● Polarity and Selectivity ● Types of Stationary Phases ● Gas-Solid Adsorption Columns*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***Gas Chromatographic Separation Effects*** *General Considerations ● Column Flow, Average Linear Velocity and Gas Viscosity ● Choice of Carrier Gas ● The Effect of – Column Length and Diameter, Stationary Phase Film Thickness and Stationary Phase Diffusivity ● The Effect of Temperature and Temperature Programming on – Column Flow, Average Linear Velocity, Solute Retention and Chromatographic Efficiency*
0930 – 0945	*Break*
0945 – 1100	***Column Selection, Installation and Use*** *Selection of the Stationary Phase and Selectivity ● Selection of the Column Diameter and Column Length ● Selection of the Stationary Phase Film Thickness ● Column Installation and Conditioning ● Column Optimization*
1100 – 1215	***Sample Injection*** *General Considerations ● Factors Affecting Injection Band Width ● Split/Splitless Injectors ● Hot Vaporizing Injection ● Programmed Temperature Vaporizing (PTV) Injector*
1215 – 1230	*Break*
1230 – 1420	***Sample Injection (cont'd)*** *Cool On-Column Injection ● Large Volume Injection ● Purge and Trap Sampling ● Headspace and Purge and Trap Sampling*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3

0730 – 0930	***GC Detectors*** *General Aspects ● Thermal Conductivity Detector ● Flame Ionization Detector ● Electron Capture Detector ● Thermionic Detector ● Photoionization Detector ● Flame Photometric Detector ● Chemiluminescent Detector*
0930 – 0945	*Break*
0945 – 1100	***GC/MS*** *MS Capillary Columns ● Ionization Sources - Electron Impact Ionization and Chemical Ionization ● Mass Analyzers – Time of Flight, Magnetic Sector, Ion Trap and Quadrupole Mass Analyzers*
1100 – 1215	***GC/MS (cont'd)*** *Mass Fragment Detection ● Total Ion Chromatograms ● Selective Ion Monitoring*
1215 – 1230	*Break*
1230 – 1420	***High Speed GC*** *Column Design and Operating Conditions ● Inlet Systems for HSGC ● Detectors for HSGC ● High Speed Temperature Programming ● Portable and Miniaturized HSGC Systems*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

Day 4

0730 – 0830	***Practical Demonstration Course*** *Agilent GC Course ● Induction and Familiarization with the Instrument ● Preparation of Gasoline Test Mixture with 3 Levels of Standard Concentrations for Method Development and Calibration*
0830 - 0845	*Break*
0845 – 1030	***Practical Demonstration Course (cont'd)*** *Setting Initial Method Parameters and Running the First Standard Mixture ● Printing of Chromatogram and Discussions on Method Shortcomings and Parameter Adjustments to Achieve Component Resolution*
1030 – 1230	***Practical Demonstration Course (cont'd)*** *Column Flow Rate, Oven Temperature Profile and Integration Parameter Adjustments through Various Runs of the Mixture until Participants Develop the Method to Achieve Full Component Resolution*
1230 -1245	*Break*
1245 - 1420	***Practical Demonstration Course (cont'd)*** *Method Calibration & Analysis of the Gasoline Sample ● Septa, Inlet Liner, Column Cutter Demonstrations ● Other Demonstrations of the GC and Software ● Breaks throughout as Required*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Four*

Day 5

0730 – 0930	***Validation of GC Methods*** *Installation Qualification (IQ) ● Operational Qualification (OQ) ● Performance Qualification (PQ) ● Method Validation – Selectivity, Initial Calibration, Linearity, Accuracy, Precision, Range, Limit of Detection, Limit of Quantification, Ruggedness and Robustness ● Sample Tracking and Chain of Custody*
0930 – 0945	*Break*
0945 – 1215	***Troubleshooting and Applications*** *General Considerations ● Use of Test Mixtures ● Column Bleed, Temperature and Oxygen Effects, Column Rejuvenation*
1215 – 1230	*Break*
1230 – 1300	***Troubleshooting and Applications (Cont'd)*** *Peak Distortion, Column Coupling and Junctions, Flame Jet Problems ● Other Problems ● Petroleum and Chemical Related Applications*
1300 – 1345	***Summary/Open Forum and Course Evaluation***
1345 - 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Practical Sessions/Site Visit

Site visit will be organized during the course for delegates to practice the theory learnt:-

Course Coordinator

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