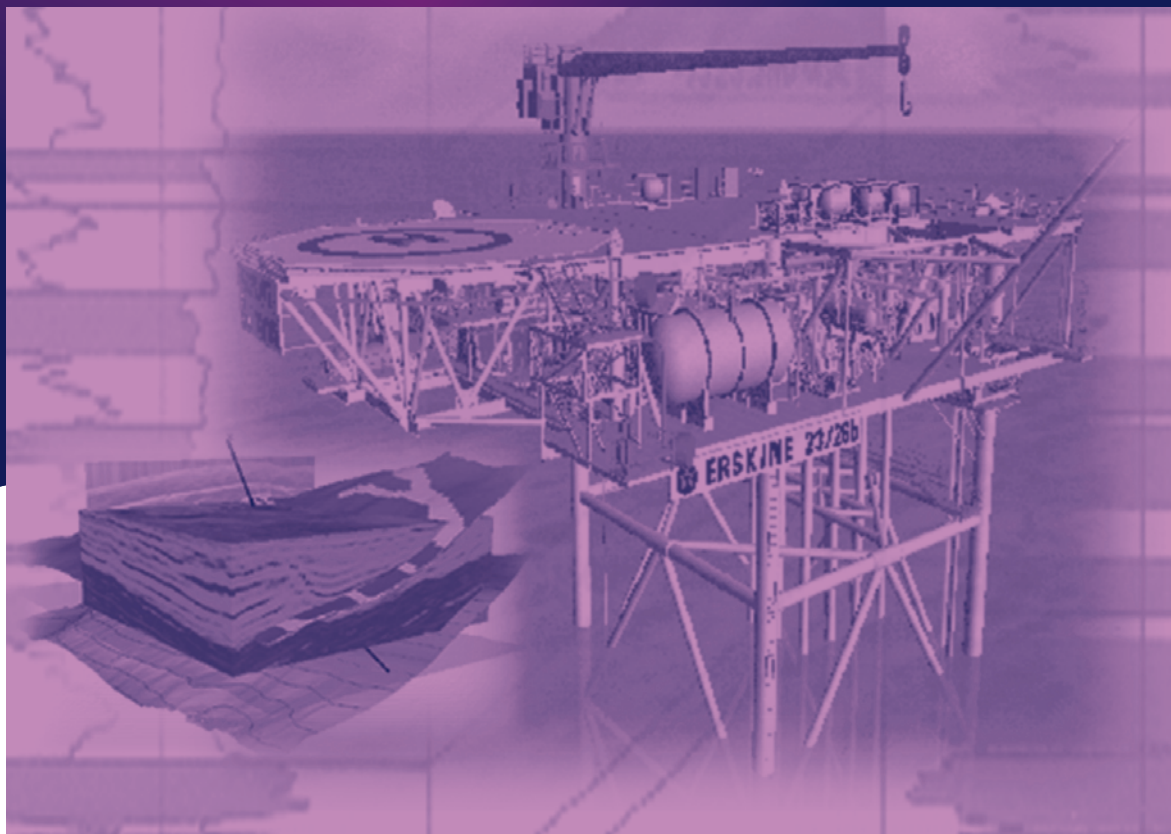


**Imperial College
London**

SHORT COURSES IN PETROLEUM ENGINEERING

2016 - 2017



**ORGANISED BY THE
CENTRE FOR PETROLEUM STUDIES
AS PART OF IMPERIAL COLLEGE LONDON'S
PROGRAMME FOR PROFESSIONAL DEVELOPMENT**

BACKGROUND

Imperial College London has a long history of both research and teaching in petroleum-related subjects. It has also a strong involvement with professionals and companies in this essential industry. As part of these activities an annual MSc course in Petroleum Engineering is presented, which is directed towards training professionals in the work flow concepts now prevailing in the oil industry and producing engineers that are fully prepared to work effectively in multi-disciplinary teams. The programme of this MSc is modular and in response to numerous requests many of the modules have been made available to practising industry professionals, who might require updating in various subjects.

SCOPE AND OVERALL STRUCTURE

The overall structure is intended to give those attending the full programme a thorough understanding of the reservoir management process, including:

- the fundamental concepts of reservoir characterisation, reservoir modelling, reservoir simulation, and field management;
- the links between the various types of data; and
- the processes for integrating and processing all available information in order to make improved reservoir management decisions.

Although each course is free standing, they have been grouped into appropriate modules:

- **Fundamental Knowledge** on the reservoir, fluids, production mechanisms, drilling and flow in porous media equations.
- **Reservoir Characterisation** addresses the reservoir characterisation process and the integration of knowledge from various types of data into a reservoir model.
- **Well Performance** deals with well performance prediction.
- **Reservoir Performance** is concerned with simulating the behaviour of the reservoir model and the predicting reservoir performance.
- **Field Development** concentrates on surface facilities and issues concerning health and safety.

WHO SHOULD ATTEND?

These courses will be suited to petroleum engineering professionals, who have the necessary background and who wish to develop their knowledge in specialist areas. Topics covered will be beneficial to professionals in the earth sciences (geology and / or geophysics); professionals in natural sciences and engineering, who are likely to be involved in integrated field and reservoir studies, appraisal/development or reservoir management; and to those who want to learn about the current best practice in the oil and gas industry.

CENTRE FOR PETROLEUM STUDIES (CPS) AT IMPERIAL COLLEGE LONDON

The Centre for Petroleum Studies is a focus for research, postgraduate teaching and professional development within the disciplines of petroleum sciences and engineering at Imperial College London. Its main objectives are to facilitate multi-disciplinary research between geologists, geophysicists, petroleum engineers and members of other key disciplines in order to advance the state of the art in exploration, appraisal/development and reservoir management. Related postgraduate teaching programmes, which reflect current best practice within the petroleum industry, are also planned and implemented. The course is managed by Professor M. Blunt. It is supported by over 20 specialist internal and external staff with over 160 years of cumulative industrial experience. The course also benefits from contributions from industry professionals. The course runs for 12 months and is aimed at providing the necessary background for employment in the oil and gas industry or a springboard for a research degree, as well as providing an in-depth study and consolidation for those already working in industry

Further **technical** details on these course may be obtained from;

Professor Martin Blunt,

Centre for Petroleum Studies, Department of Earth Science and Engineering,
Imperial College London,
Prince Consort Road, London SW7 2AZ, UK.

Tel:+44 (0)20 7594 6500 **Email:** m.blunt@imperial.ac.uk

Requests for further information about the **12 months MSc program** should be made via
MSc Admissions

Centre for Petroleum Studies
Department of Earth Science and Engineering
Imperial College London,
Prince Consort Road, London SW7 2BP, UK
Tel:+44 (0)20 7594 7440
Email: a.gringarten@imperial.ac.uk
Web: www.eese.ic.ac.uk

PROGRAMME OUTLINE

MODULE 1: FUNDAMENTAL KNOWLEDGE

PETROLEUM GEOLOGY (21 HOURS) - Introduction to the basic fundamentals of geology. Influence of Geologic Characteristics on Appraisal and Development. Depositional Controls. Pore Space Properties. Aquifer Characterisation. Reservoir Zonation and Thickness Mapping. Reservoir Characterisation and Geological Modelling.

PRODUCTION MECHANISMS (3 HOURS) - Primary and improved/enhanced oil recovery. Primary oil production; reservoir drives and production mechanisms; solution gas, gas cap, aquifer, gravity drainage, compaction. Recovery factors. Secondary recovery; waterdrive, gas injection. IOR/EOR. Life of field recovery processes. Gas reservoirs; water influx effects on gas reservoir production. Concepts of depletion planning from reservoir mechanistic point of view. Composition and how it affects reservoir behaviour.

DEFINITION OF HYDROCARBON RESERVES (3 HOURS) - Reserve definitions and guidelines. Volumetric derivation of hydrocarbons in-place. Assessment of recovery factor. Risk and uncertainty in resource estimation. Deterministic and probabilistic methods.

INTRODUCTION TO PETROLEUM RESERVOIR FLUIDS (18 HOURS) - Phase Behavior, dew and bubble point lines, retrograde condensation; PVT behaviour, Peng-Robinson EOS, Phase Equilibria, Rachford-Rice equation, K-values, correlations, fugacity, Thermophysical properties of reservoir fluids.

FLUID FLOW IN POROUS MEDIA (27 HOURS) - Diffusivity equation. Line-source solution. Build-up, multi-rate flow tests and superposition in time. Linear boundaries and superposition in space. Inner and outer boundary conditions. Advanced mathematical methods. Flow of gases in porous media. Multi-phase flow.

MODULE 2: RESERVOIR CHARACTERISATION

WELL TEST ANALYSIS (36 HOURS) - Interpretation model. Identification, verification and mathematical representations. Well test interpretation techniques (straight-line, pressure log-log and pressure derivative analyses). Near wellbore effects, reservoir behaviours, outer boundaries. Gas wells. Multiphase flow. Special tests. Test design. Practical considerations.

PETROPHYSICS (48 HOURS) - Coring: coring and core analysis. Routine (RCAL) and special core analysis (SCAL); sampling strategy; sample screening and preparation; validity of samples and tests; correlations; application of data in reservoir calculations. Log analysis: borehole environment, invasion and resistivity profiles. Electrical, nuclear and sonic logs. Porosity, lithology, saturation and permeability estimation. Practices and pitfalls of formation evaluation.

GAS INJECTION (9 HOURS) - Practical aspects of the gas injection process. Best practices of the gas-based enhanced oil recovery (EOR). Identify key enablers and disablers of the gas injection projects

MODULE 3: WELL PERFORMANCE

WELL CONSTRUCTION: DRILLING AND COMPLETION (18 HOURS) - On-shore and off-shore drilling and well engineering. Drilling fluids and fluid systems. Special drilling operations. Well control. Environmental concerns & compliance. Influence of well design and well completion. Effects of depletion, water cut, pressure cycling and shut-in. Reservoir compaction, casing collapse and subsidence. Bottom-hole completions and treatments.

PRODUCTION ENGINEERING/WELL PRODUCTION (27 HOURS) - Flow of fluids into the wellbore. Single and multi-phase fluid flow in pipes. Productivity Index (PI) and Inflow Performance Relationships (IPR) for oil and gas wells. Nodal analysis. Gas condensate wells. Complex wells. Well deliverability for oil and gas wells. Artificial lift systems.

MODULE 4: RESERVOIR PERFORMANCE

RESERVOIR PREDICTION (24 HOURS) - Material Balance: Conservation of mass and volume. Gas reservoirs. Oil reservoirs. Accuracy of material balance equation. Fluid displacement models: Immiscible displacement calculations. Recovery factor. Microscopic, vertical and areal sweep efficiencies. Stratified reservoirs. Decline curves: Exponential, hyperbolic, Fetkovich decline curve analysis. Ranges of validity. Streamline simulators.

NUMERICAL RESERVOIR SIMULATORS (21 HOURS) - Reservoir simulation and reservoir management. Types of reservoir simulators. Basic concepts. Finite differences. Practical use (data preparation; initialisation; time step size and grid selection). Aquifer modelling. Use and abuse of simulators. Alternative techniques.

UPSCALING (9 HOURS) - Requirements for upscaling. Upscaling of scalar properties and two-phase. Limitations. Validation of upscaled model and best practice.

PETROLEUM ECONOMICS (12 HOURS) - Capex and Opex. Future cash flows. Measures of financial performance. Effects of phased and incremental projects. Leasing and outsourcing. General frameworks for taxation. Probabilistic and Monte-Carlo models. Decision theory and criteria. External financing and loans. Futures markets.

ENHANCED OIL RECOVERY (12 HOURS) - Water and hydrocarbon PVT behaviour (formation volume factors, solution gas oil ratio etc.) principal recovery mechanisms (primary: gas cap drive, aquifer, compaction etc., secondary: waterflood, tertiary: miscible, WAG etc.) Darcy's Law, relative permeabilities, definition of fractional flow.

MODULE 5: FIELD DEVELOPMENT

PROCESS ENGINEERING AND SURFACE FACILITIES (27 HOURS) - Introduction to surface operations. Fluid separation. Equilibrium flash calculations. Processing and conditioning of gas condensates and natural gases. Hydrocarbon transportation and storage.

HEALTH, SAFETY AND ENVIRONMENT (3 HOURS) - Occupational safety and health. Legal and administrative aspects. Hazard identification and assessment. Managing for safety. Piper-Alpha tragedy and the Cullen report. Abandonment issues.

LECTURE SELECTION SHEET 2016 - 2017

Courses	No of 3hr sessions	Presenter	Schedule	Lecture Fee
MODULE 1: FUNDAMENTALS				
Petroleum Geology	7	P. Fitch	Oct 4, 5, 6, 7 (am)	£1505
Geostatistics	4	P. King	Oct 10 (pm), 11, 12 (am)	£860
Reservoir Fluids	6	V. Vesovic	Nov 10, 11, 14	£1290
Production Mechanisms	1	M. Blunt	Oct 21 (am)	£215
Definition of Hydrocarbons Reserves	1	S. Purewal	Oct 21 (pm)	£215
Fluid Flow in Porous Media	9	R. Zimmerman	Oct 20, 25 (pm), 26, 27, 28,	£1935
MODULE 2: RESERVOIR CHARACTERISATION				
Gas Injection	3	S. Suicmez	Oct 24, 25 (pm)	£645
Petrophysics	15	P. Fitch & M. Jackson	Oct 31 Nov 1, 2 (am), 3, 4, 7, 8, 9	£3225
Well Testing	12	A. C. Gringarten	Nov 16 (pm), 17, 18 , 21, 22,23, 24 (am)	£2580
MODULE 3: WELL PERFORMANCE				
Well Construction: Drilling and Completion	6	M. Dyson	Jan 10(pm), 11, 12, 13(am)	£1290
Production Engineering/ Well Performance	9	G. Falcone	Jan 23 (pm), 24, 25, 26, 27	£1935
MODULE 4: RESERVOIR PERFORMANCE				
Reservoir Prediction	8	M. Blunt	Jan 13(pm), 16, 17, 18, 19(am)	£1720
Enhanced Oil Recovery	4	S. Krevor	Jan 19 (pm), 20, 23(am)	£860
Upscaling	3	O. Gosselin	Feb 2(pm), 3	£645
Numerical Reservoir Simulators	7	D. Waldren	Jan 30, 31 Feb 1, 2 (am)	£1505
Petroleum Economics	4	E. Jankowski	Feb 28 March 1	£860
MODULE 5: FIELD DEVELOPMENT				
Process Engineering & Surface Facilities	9	I. Ellul	March 6, 7, 8, 9, 10 (am)	£1935
Health, Safety & Environment	1	T. Ingram	March 13 (pm)	£215

am = 09:00 - 12:00

pm = 14:00 - 17:00

THE PRESENTERS

Professor Martin Blunt

Professor Blunt's research interests are in multiphase flow in porous media with applications to oil and gas recovery, geological carbon storage and contaminant transport and clean-up in polluted aquifers. He performs experimental, theoretical and numerical research into many aspects of flow and transport in porous systems, including pore-scale modelling of displacement processes, and large-scale simulation using streamline-based methods. He is on the editorial boards of *Transport in Porous Media*, *Water Resources Research* and *Advances in Water Resources*. He was the Chair of the 2006 Gordon Conference on Flow in Permeable Media. He has over 200 scientific publications.

Professor Oliver Dubrule

Olivier Dubrule obtained a PhD Degree in Petroleum Geostatistics at Ecole des Mines de Paris in 1981. After managing the Total Geosciences Research Centre (Aberdeen, UK) and the Total Research Centre – Qatar (Doha, Qatar), Olivier became Vice-President of Geosciences Training and Technical Image in Pau (France) in January 2012. He has been seconded by Total at Imperial College since November 2014. Olivier is the author of AAPG Course Notes Series #38 "Geostatistics in Petroleum Geology", of SEG/EAGE course notes "Geostatistics for Seismic Data Integration in Earth Models", translated in Farsi and Russian. He was SEG/EAGE Distinguished Short Course Instructor in 2003 and the 2004-2005 President of EAGE.

Professor Alain C. Gringarten

holds the Chair of Petroleum Engineering in the Department of Earth Science and Engineering at Imperial College London, where he is also director of the Centre for Petroleum Studies. Prior to joining Imperial in 1997, he spent fourteen years with Scientific Software-Intercomp; five years with Schlumberger; and five years with the Bureau de Recherches Géologiques et Minières in Orléans, France, in various technical and management positions. Professor Gringarten is a recognised expert in well test analysis. He received the Society of Petroleum Engineers (SPE) Formation Evaluation Award for 2001, the SPE John Franklin Carlil Award in 2003 and the SPE Cedric K. Ferguson Certificate in 2005. He holds a MSc and a PhD in Petroleum Engineering from Stanford University; and an engineering degree from Ecole Centrale Paris, France. He was elected a SPE Distinguished Member in 2002 and has recently served as a SPE Distinguished Lecturer.

Dr Ivor Ellul

is the founder and Chief Executive Officer of Knowledge Reservoir, Inc. L.P. in Houston. Prior to this, he spent three years with Smedvig Technologies Inc., two years with Schlumberger GeoQuest, and five seven years with Scientific Software Intercomp, in various technical and management positions. Dr Ellul's expertise is, among other things, in the modelling of multiphase flow in pipelines under steady-state and transient conditions. Dr Ellul holds a BSc in Mechanical Engineering from the University of Malta, and an MSc and a PhD in Petroleum Engineering from Imperial College London. He is a registered Professional Engineer in the State of Texas and a registered Chartered Engineer in the United Kingdom.

Professor Peter King

holds the Chair in Petroleum Engineering in the Centre for Petroleum Studies, Department of Earth Science and Engineering, Imperial College London. He spent 17 years with BP at their technology centre in Sunbury-on-Thames where he worked on a wide variety of subjects applying methods of mathematical physics to reservoir characterisation and modelling. Professor King is a Fellow of both the Institute of Physics and the Institute of Mathematics and its Applications; a Royal Academy of Engineering Visiting Professor in the Department of Engineering at Cambridge University; a Visiting Scholar in the Department of Physics at Boston University; and a member of the Physics College of the EPSRC. He was a deputy editor of *Petroleum Geoscience*. Professor King holds

a PhD in theoretical statistical physics from Cambridge University.

Dr François Montel

works as a thermodynamics and fluids expert for Total in Pau. He studied engineering physics at Ecole Supérieure de Physique et de Chimie Industrielles in Paris and has a PhD from the University of Paris. He has many years industrial experience in petroleum engineering, PVT laboratory and process engineering. He has worked for Elf, TFE, and Total for 25 years. He has taught at the Ecole Supérieure de Physique et de Chimie Industrielles in Paris and is also an associate professor at IFP School and the University of Pau. He has numerous publications in journals and conference proceedings.

Professor Velisa Vesovic

is Professor of Transport Phenomena in Imperial College London. His expertise is in thermophysical properties, heat transfer and computational modelling and has recently embarked on research in the area of environment engineering. The current research interests are in understanding and modelling the dispersion phenomena associated with industrial or accidental releases of pollutants into fluid media and their subsequent environmental impact. He has published over fifty papers and reviews in refereed scientific literature and acts as a consultant to the chemical and environmental industry. He graduated in 1978 in Chemical Engineering at Imperial College and was awarded a PhD in 1982.

Dr David Waldren

is director of Petroleum Consulting and Training Limited and a Visiting Professor to the Centre for Petroleum Studies, Department of Earth Science and Engineering, Imperial College London. He has been a consulting reservoir engineer for over 25 years, previously having been with BNOC, Intercomp, and IPEC. He is recognised worldwide for his reservoir management and simulation advice. He has a PhD in particle physics from Liverpool University.

Dr Robert Zimmerman

Robert Zimmerman obtained a BS and MS in mechanical engineering from Columbia University, and a PhD in solid mechanics from the University of California at Berkeley. He has been a lecturer at UC Berkeley, a staff scientist at the Lawrence Berkeley National Laboratory, and Head of the Division of Engineering Geology and Geophysics at the Royal Institute of Technology (KTH) in Stockholm. He is the Editor-in-Chief of the *International Journal of Rock Mechanics and Mining Sciences*, and is on the Editorial Boards of *Transport in Porous Media* and the *International Journal of Engineering Science*. He is the author of the monograph *Compressibility of Sandstones* (Elsevier, 1991), and co-author, with JC Jaeger and NGW Cook, of *Fundamentals of Rock Mechanics* (4th ed., Wiley-Blackwell, 2007).

GENERAL INFORMATION

ONLINE REGISTRATION

To book a place please visit our website:

www.imperial.ac.uk/cpd/peteng

For any queries please contact us on:

PHONE: +44 (0)20 7594 6884

EMAIL: cpd@imperial.ac.uk

Detailed joining instructions, including a map, will be sent to all participants 10-14 days prior to the commencement of the course. Places on these courses are limited, **EARLY BOOKING IS ADVISED**.

FEES

The course fee is charged per 3 hour session, please see lecture selection sheet enclosed. This covers tuition, course supporting material and lunches but does not cover accommodation.

VENUE

The course will be held at the Department of Earth Sciences and Engineering, Royal School of Mines Building, Imperial College London, Prince Consort Road, London, SW7 2BP.

ACCOMMODATION

Single bedroom accommodation is available in local hotels within easy access to the College. Minimum cost of a room with shower/bath will be in the region of £85 per night. This is additional to the course fee, and participants are responsible for payment of their hotel bills. For further details and reservations, please contact:

HOTEL BOOKING SERVICE,

Imperial College London Conference Office,

Tel: +44 (0)20 7594 9507/11

Email: accommodationlink@imperial.ac.uk

Information is also available at:

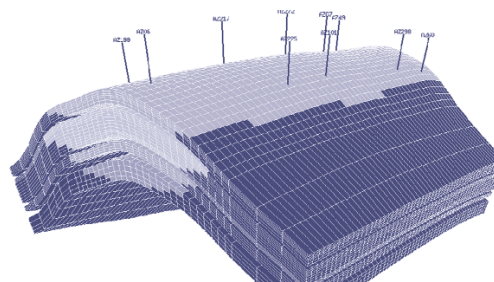
www.imperial.ac.uk/conferences

CANCELLATIONS

A 20% administration fee will be levied for cancellations made up to two weeks prior to the start of the course. Cancellations thereafter will be liable to the loss of the full fee.

Notice of cancellation must be given in writing by letter or fax and action will be taken to recover, from the delegates or their employers, that proportion of the fee owing at the time of cancellation.

The College reserves the right to cancel an advertised course at short notice. It will endeavour to provide participants with as much notice as possible, but will not accept liability for costs incurred by participants or their organisations for the cancellation of travel arrangements and/or accommodation reservations as a result of the course being cancelled or postponed. If a course is cancelled, fees will be refunded in full. The College also reserves the right to postpone or make such alterations to the content of a course as may be necessary.



QUERIES

Queries regarding registration and other administration matters should be directed to:

Stephen Godfrey

Centre for Continuing Professional Development

Imperial College London

Exhibition Road

London, SW7 2AZ, UK

Tel: +44 (0)20 7594 6884

Email: cpd@imperial.ac.uk

Technical queries should be directed to;

Professor Martin Blunt,

Centre for Petroleum Studies

Department of Earth Science and Engineering

Imperial College London

Prince Consort Road

London SW7 2AZ, UK

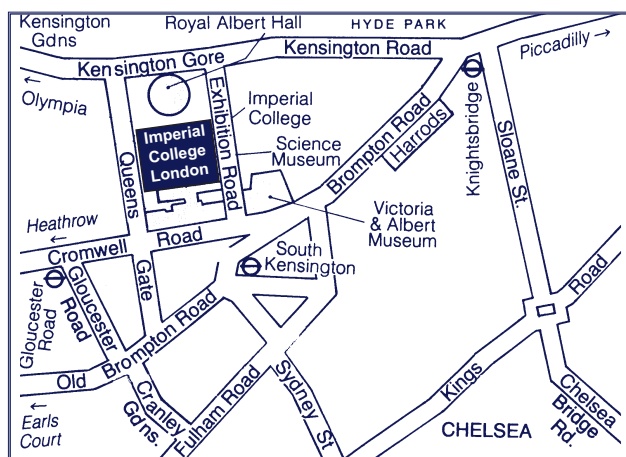
Tel: +44 (0)20 7594 6500

Email: m.blunt@imperial.ac.uk

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www.imperial.ac.uk/cpd

How to find us:



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