Summary
This course will provide an overview of different synthetic seismic modelling concepts, methods and applications for seismic calibration and better reservoir characterisation in different areas of the E&P business. It will demonstrate the effectiveness of synthetic modelling techniques through practical examples.

Learning Outcomes
Participants will learn to:

1. Undertake appropriate QC, editing and synthesis of well logs.
2. Apply depth to time conversion and understand the associated issues.
3. Calculate elastic properties (Moduli, Vp, Vs, rho) and use them to predict the seismic response.
4. Differentiate the different types of wavelets (zero phase, minimum phase, mixed phase).
5. Use well-based (log and VSP) and statistical techniques for wavelet estimation.
6. Critique the role of VSPs in directly estimating rock properties such as Q and anisotropy.
7. Calculate zero-offset and angle-dependant synthetic seismic models.
8. Employ 1-D fluid replacement models for feasibility studies and to validate and cross check AVO studies.
9. Understand the role of 2D/3D synthetic modelling (ray trace, acoustic and elastic wavefield modelling) to design and QC acquisition and processing workflows and to validate interpretation.
10. Determine the value of synthetic modelling to exploration and reservoir characterisation.

Duration and Training Method
A three day classroom course that comprises of classroom instruction, worked examples, exercises and discussions.

Who Should Attend
This course is designed for geoscientists using seismic data for exploration, appraisal and development, especially those using it for quantitative analysis and prediction of lithological and fluid properties.

Prerequisites and Linking Courses
There are no specific prerequisite courses, but participants should have an understanding of the seismic process and be prepared for some technical discussion.

This course expands on concepts introduced in classes N080 (Geophysics for Sub-Surface Professionals), N092 (Fundamentals of Reservoir Geophysics) and N066 (An Objective Approach to Seismic Acquisition, Processing and Reprocessing) and complements the geophysical courses addressing quantitative interpretation such as N004 (Essentials of Rock Physics), N032 (Professional Level Rock Physics for Seismic Amplitude Interpretation) and N306 (A Practical Introduction to Seismic Inversion).
Course Content

The course covers all aspects of the use of seismic forward modelling to help with the design of seismic acquisition, processing and interpretation and to provide calibration of seismic data. Contents include:

1. Introduction: Synthetic modelling concepts, types of modelling, application in different areas of E&P.
2. Basics of sonic, density, and other logs.
3. Editing of well logs, cycle skipping, borehole caving. Importance and limitations of each log. Use of log transforms for QC and to replace missing data.
4. Methods of depth to time conversion and associated issues.
5. Elastic properties (Moduli, Vp, Vs, rho) and their relation to the seismic response.
6. Different types of wavelets (zero phase, minimum phase, mixed phase) and their applicability and limitations. Wavelet extraction using different techniques (statistical, well constrained, using logs and VSPs). Use and mis-use of standard wavelets.
7. The well to seismic tie and its importance.
8. The use of VSPs for calibration including estimation of P and S-wave anisotropy and the absorption quality factor, Q.
10. Generation of 1-D fluid replacement models for feasibility studies and to validate and cross check AVO studies.
11. Generation of 2D synthetic seismic sections to validate inversion results.
12. Use of ray trace travel time and illumination modelling to help design, acquire and process surface seismic and VSP data.
13. 2D/3D synthetic seismic modelling (ray trace, acoustic and elastic wavefield modelling) to design acquisition and processing workflows.
14. 2D/3D synthetic modelling for 3D seismic interpretation in geologically complex areas.
15. Examples to demonstrate the value addition from these modelling studies.