PACT PROCESS AUTOMATION
PARTNERSHIP IN AUTOMATION AND CONTROL TRAINING

Batch Processing and Automation

Code:	ACS 672	Revised: 21st July 05
Module:	Optional.	
Time allocation:	Lectures) Tutorials) Practicals)	40 hours
	Assignment	40 hours
	Private study	50 hours
Prerequisites:	First degree or equivalent in an appropriate discipline.	
Weighting:	15 credits.	
Assessment:	By report on assignment. By 1 x 2 hour examination.	
Lecturers:	D Adams, P Burton, O Lewis, J Love, F Lovering and N Taylor.	
Location:	Newcastle University	

Aims

To develop an understanding of the nature of batch processing and of the issues involved in specifying requirements and developing application software for batch process control in relation to the structures and terminology of the relevant IEC standards.

Objectives

To understand the sequential nature of batch processing and the structures of different batch plant types.

To recognise the regulatory constraints (auditing, traceability, quality, etc) that apply in different batch processing sectors (eg pharmaceuticals).

To appreciate the distinction between sequence control and batch process control, and how the former provides a basis for the latter.

To understand the principal constructs of the IEC 61131 (Part 3) and 61512 (S88) standards for batch automation and how they relate to major equipment items.

To become aware of the functionality of proprietary systems (PLC, SCADA, etc) for sequencing and batch process control applications.

To develop a feel for good practice in relation to the development of application software and the management of major software projects.

Phasing

It is desirable, but not essential, that delegates have completed (or have some familiarity with the material covered in) the Control Schemes and Strategies (ACS 676) and the Control System Technology (ACS 678) modules before doing this one.

Study Modes

This module is of one week's full-time intensive study consisting of a variety of formal lectures, a substantive case study and demonstrations. It is followed by an assignment to be carried out in the delegate's own time.

Recommended Texts

Fisher T, Batch Control Systems: Design, Application and Implementation, ISA, Carolina, 1990.

Fleming D W & Pillai V, S88 Implementation Guide, McGraw Hill, 1998.

Lewis R W, Programming Industrial Control Systems using IEC 1131-3, IEE, London, Revised Edition, 1998.

Parshall J & Lamb L, Applying S88: Batch Control from a User's Perspective, pub ISA, 2000.

Sawyer P, Computer Controlled Batch Processing, pub by IChemE, 1993

Topics Included

Batch processing. Distinction between batch, semi-batch and continuous processes. Examples of batch plant: weigh vessels, filters, reactors, etc. Examples of batch processes: distillation, etc. Plant structures: multi-stream, multi-products and multi-purpose plant. Shared equipment. Processing cells and flexibility. Parallel and sequential operations. Sequencing as a time series of events. Safety issues and concept of hold/safe states. Automatic start-up and shut-down.

Sequence control: Role of discrete signals for status, safety, isolation, etc. Confirmation of status. Concepts of sequence logic. Absolute, lapsed and implicit timing. The IEC 61131 Standard (Part 3). Datatyping and structured text. Worked example on a charging operation. Decision trees and tables. Indirect addressing and parameter lists. Real time execution of sequences. Ladder logic. Contacts, coils and rungs. Ladder execution. Integration of sequence and continuous control. Timers and counters. Demonstration of the functionality of proprietary PLCs. Sequential function charts (SFC). Sequence structures: phases, steps and transitions, actions and qualifiers. Parallelism. Interface between sequencing and function blocks for analogue control. Pros and cons of procedural vs configurable approaches.

Batch automation: The IEC 61512 Standard (ISA SP 88) and standard terminology. Plant structures and physical (equipment) models. Major equipment items (MEI) as units and constraints on unit boundaries. Shared resources and contention handling, eg inter-vessel transfers. Process models. Procedural models and structures. Constraints on operation and phase boundaries. Configurability of phases. Design for common and parallel operations. Recipe models: types and translation. Activity models: recipe, batch and unit management, reporting, production planning and scheduling, etc. Mapping between models. Case study on model decomposition. Demonstration of functionality of proprietary batch automation system.

Projects: Batch specific aspects of application software projects: Feasibility studies. Economics of automation: costs and benefits. Turnkey projects and time scales. Software life cycle and "waterfall" model. User requirements specification (URS): information to be provided, commercial considerations etc. Tender generation and compliance commentary. Tender analysis and supplier selection. Detailed functional specification (DFS): methodology, participants, documentation. Software design and mapping of requirements into IEC 61131 and 61512 constructs. Design

walkthroughs. Structured development and programming concepts, eg Yourdon. CASE tools for development and IPSE for support. Coding, testing, verification, integration and acceptance. Test methods, including model based testing. Integration of third party software. Commissioning: functional testing of instrumentation, plant interfaces and applications software. Site acceptance. Project planning: effort estimates, software management and programmer efficiency. Progress monitoring and “metrication”. Maintenance and upgrades. Replacement.

Software QA: The ISO 9000 standard (Part 3). GAMP: definition, purpose, scope and benefits. Statutory requirements, eg FDA. Overview of validation. Quality management systems for suppliers. Procedures for project and quality plans, specifications, software design and production. Procedures for configurat ion and software review, change and version control, testing and documentation. Case study on development of a URS.