APPENDIX A **Matriculation Number:**

(Note: this document was issued to all candidates prior to the examination as pre-reading material)

EXTRACT FROM THE XPRESS SYSTEMS QUALITY MANUAL

1. Requirements Control

For a project to be successful it is essential that Customer requirements are understood, documented and accepted by the Customer. The required procedures are defined in the following subsections.

1.1 Requirements Analysis

The Project Leader is responsible for ensuring that sufficient steps are taken to understand the Customer's requirements and assess their feasibility. The activities to be performed should be described in the Project Plan. The approach to be taken or methodology to be followed to perform the requirements analysis should be defined in the Quality Plan.

1.2 Requirements Specification

The requirements analysis should result in the production of some form of documented Requirements Specification. In producing this specification it is important that every effort is made to ensure that the document reflects the actual Customer requirements. The requirements should be defined in such a way that they are testable. Guidance on producing requirements specifications is given in the guideline **XPRESS/QMS/QS.7** *Guide to Producing User Requirement Specifications (not included in this extract).*

1.3 Requirements Review

The completed specification should be internally reviewed to ensure that all ambiguities, errors and omissions are resolved. The main reviewer should be the Project Leader (or by a Software Engineer if the Project Leader is the main author of the document). If the specification passes the review then it should be approved. The Project Manager is responsible for reviewing the approved document to ensure that contractual and commercial requirements are met, and authorising the document for release to the Customer.

Procedure XPRESS/QMS/QP.7 *(not included in this extract)* defines the generic requirements for conducting any review.

The Customer is responsible for reviewing the authorised specification and accepting it. If the document is unacceptable then the Project Leader is responsible for initiating corrective action. The corrected version should then be approved and authorised, and then re-submitted for acceptance. This process should continue until an accepted specification is produced.

The issue and control of the Requirements Specification should be managed in accordance with the Document Control requirements given in section 10.2 *(not included in this extract).*

APPENDIX A

1.4 Changes to Requirements

The Requirements Specification should form the base-line for the design phase. Also, unless otherwise agreed with the Customer, it should be used as the fundamental input to the final acceptance of the complete system. Hence, after the specification has been accepted, changes can only be made if agreed change request and approval procedures are followed which are in accordance with the Configuration Management requirements given in section 10.1 *(not included in this extract)*. Note that the change control procedures should be defined in the project's Quality Plan.

2. Design Control

Design is regarded by Xpress Systems as the most important step in transforming the Customer requirements into a working system. The overall quality and functionality of a software system depends greatly on the initial design. The same holds for ease of implementation and maintainability. Hence design activities must be carried out on all projects where, based on contractual requirements, some form of programming is required. The required procedures are defined in the following subsections.

2.1 Design Activities

Design in Xpress Systems involves defining the software system that is needed to satisfy the Customer requirements as defined in the Requirements Specification. The design can also involve identifying the structure of the system in terms of software modules. The design activities to be performed should be described in the Project Plan. The approach to be taken or methodology to be followed to perform the design work should be defined in the Quality Plan, which should include reference to appropriate design guidelines.

2.2 Design Specification

The design work should result in the production of some form of documented Design Specification. In producing this document, it is important that every effort to made to re-use existing designs, components or code. This will minimise the effort required and will also reduce the development risks. The design should be an implementable and maintainable representation of the Requirements Specification. Guidance on producing design specifications is given in the guideline **XPRESS/QMS/QS.13** *Guide to Producing Design Specifications (not included in this extract).*

2.3 Design Review

Every project must have a design review to ensure that the design work is under control and is a complete, traceable, error-free, implementable and maintainable representation. The Project Manager is responsible for appointing a review team comprising of one or more reviewers that are independent of the project. These reviewers should be appropriately qualified to understand the design, and should usually be Project Leaders from other projects. If contractually required, the Customer should also be invited to participate in the design review. The Project Leader is responsible for arranging and scheduling the design review.

The review should include a review meeting to which the Quality Manager or Assistant Quality Manager should be invited to attend.

Procedure XPRESS/QMS/QP.7 *(not included in this extract)* defines the generic requirements for conducting any review.

2.4 Issuing the Design

When the design review is completed and the required corrective action has been taken to the satisfaction of the review team, a representative from the team will be invited to approve the design. The Project Manager is responsible for reviewing the approved document to ensure that contractual and commercial requirements are met, and authorising the document for use as the basis for the software implementation. If contractually required, the authorised design will also be issued to the Customer.

The issue and control of the Design Specification should be managed in accordance with the Document Control requirements given in section 10.2 *(not included in this extract)*.

2.5 Design Changes

The Design Specification should form the base-line for the programming phase. Hence, after the specification has been accepted, changes can only be made if agreed change request and approval procedures are followed which are in accordance with the Configuration Management requirements given in section 10.1 *(not included in this extract)*. Note that the change control procedures should be defined in the project's Quality Plan.

3. Programming and User Documentation Control

To ensure the construction of reliable and maintainable software and associated user and system documentation (such as user manual, programmer's manual and operations manual) as required by the Contract, the following are required:

1. Programming standards, of some form, must be used. These should define how the program code is to be written. They may include: permitted statements, code layout, commenting conventions, and naming conventions.

2. Documentation standards, of some form, must be used. These should define how the user documentation is to be written. They may include: layout, format, content and style conventions. Following guidelines *(not included in this extract)* may be adopted by a project as standards:

   XPRESS/QMS/QS.10 Technical Documentation Guide

   XPRESS/QMS/QS.11 Guide to Writing Style

3. Reviews must take place to ensure that the programming standards are being followed correctly, and that the program code is compliant with the provisions in the Design Specification.

4. Reviews must take place to ensure that the documentation standards are being followed correctly, and that the user documentation is fit for purpose, accurate, consistent and complete.

5. The issue and control of the user documentation should be managed in accordance with the Document Control requirements given in section 10.2 *(not included in this extract).*

The Project Leader is responsible for defining the standards to be followed, and for arranging and scheduling the reviews. These should be documented in the project's Quality Plan.

Procedure XPRESS/QMS/QP.7 *(not included in this extract)* defines the generic requirements for conducting any review.

4. Testing and Validation

Xpress Systems are committed to providing appropriate testing processes to ensure that the Customer receives an error-free product that meets the contractually agreed requirements. The company further believes that money spent on thorough testing will pay for itself many times over in reduced maintenance and service costs as well as in increased Customer satisfaction. The required procedures are defined in the following subsections.

4.1 Testing Requirements

Testing may be required at several different levels from the individual software module to the complete software product. Four classes of testing activities are performed at Xpress Systems. These are as follows:

1. **Unit Test**. Testing of the individual software modules against their design as given in the Design Specification.
2. **Integration Test**. Testing of the whole system (or subsystem) to check whether the complete design has been implemented correctly and whether software modules work together as a whole.
3. **System Test**. Testing of the entire software product to check whether the Customer's requirements have been implemented and whether contractual obligations have been met.
4. **Acceptance Test**. Testing prior to delivery to enable the Customer to judge whether the product is acceptable in accordance with previously agreed criteria.

Not all these classes of testing are required for every project. However, some form of testing must be performed on every project where software is produced. The Project Leader is responsible for determining the types of testing activities required to be performed by the project team, based on technical, contractual and commercial considerations. The types of testing should be defined in the project's Quality Plan. Any standards or guidelines that must be employed to carry out the tests should also be defined in the Quality Plan. The schedule and resources for the testing activities should be defined in the Project Plan.

4.2 Test Planning

Testing which is carried out in an un-planned manner, which is usually characterised by random attempts to find errors, is of limited value. Planning is the simplest way to ensure that the required tests are performed correctly. Hence, some form of Test Plan document must be

produced to plan and control a project's testing activities. Guidance on test planning is given in the guideline **XPRESS/QMS/QS.14** *Guide to Test Planning (not included in this extract).* The Test Plan should include the following:

1. Description of the data to be used in the tests.
2. Instructions to be followed to perform each test.
3. Expected results of each test.
4. The test environment (hardware, software etc).
5. Requirements for test results documentation. Guidance on the form that this documentation should take is given in the guideline **XPRESS/QMS/QS.17** *Guide to Test Results Documentation (not included in this extract).*
6. The procedure to follow to report errors and problems discovered during testing.

The Test Plan should be approved by the Quality Manager or Assistant Quality Manager and authorised for use by the Project Manager.

The issue and control of the Test Plan should be managed in accordance with the Document Control requirements given in section 10.2 *(not included in this extract).*

4.3 Testing

The staff tasked by the Project Leader to carry-out the testing activities should follow the instructions given in the authorised Test Plan and adhere to any relevant guidelines defined in the Quality Plan. In particular, it is important that:

1. Test results are documented as described in the Test Plan.
2. Test results are filed in the project filing system as defined in Quality Plan.
3. Errors and problem discovered during testing should be reported in accordance with the procedure defined in the Test Plan.
4. Appropriate corrective action should be taken to resolve the reported errors and problems. These should be tracked by the Project Leader until closure.

The Project Leader is responsible for reviewing the test results documentation to ensure that the tests have been satisfactorily completed.

5. Acceptance

When the test results have been approved, the software can be submitted for customer acceptance. If acceptance criteria have not been agreed with the Customer, then this phase of the project can be complicated and lead to significant pressure and ill will. Furthermore, failure to manage acceptance issues in the early stages of a project will almost certainly lead to cost and schedule overruns at this phase.

Hence, to ensure that customer acceptance is handled correctly, the acceptance process must be documented and agreed with the Customer. If this does not form part of another project document (such as the Proposal or Requirements Specification) then some form of Acceptance Test Plan must be produced. The Acceptance Test Plan should provide a process

by which the Customer can judge whether the contractual requirements have been met. It should include the following:

1. The acceptance criteria. This should be derived from the Requirements Specification, unless otherwise agreed with the Customer.
2. Procedures to be followed to enable the Customer to undertake the evaluation. This may include the specification of a series of acceptance tests.
3. Definition of the required software, hardware and human resources.
4. The procedure to follow to report errors and problems discovered during the acceptance process.

The Acceptance Test Plan should be approved by the Quality Manager or Assistant Quality Manager, authorised for use by the Project Manager and accepted by the Customer.

The issue and control of the Acceptance Test Plan should be managed in accordance with the Document Control requirements given in section 10.2 *(not included in this extract).*

To conduct Customer acceptance the provisions of the Acceptance Test Plan (or its equivalent) should be followed. If errors or problems are discovered they should be reported and corrective action should be initiated. These should be tracked by the Project Leader until closure. When all outstanding problems and errors are resolved, the Customer should be invited to formally accept the software.

6. Delivery and Installation

The accepted software system should be delivered and installed in accordance with contractual requirements. The following are required:

1. Prior to delivery, the software product should be stored on an appropriate medium (usually diskette). The media should be labeled with the name of the software product and its release as identification.
2. The software should be accompanied, unless otherwise agreed with the Customer, by the contractually agreed associated documentation (such as user and operations manuals). These documents should be labeled with the name of the software product and its release.
3. On installation some mechanism should be used to demonstrate that the correct software has been installed, and that it operates satisfactorily. This may involve re-running a pre-defined subset of the acceptance tests. The exact procedures to be followed should be documented in the project's Quality Plan.

If errors or problems are discovered during installation, they should be reported to the Project Leader, who should initiate corrective action. These should then be tracked by the Project Leader until closure. When all outstanding problems and errors are resolved, the Customer should be invited to formally *approve the delivery*.