


<b>Cover Sheet for Proposals</b> <i>(All sections must be completed)</i>			
<b>Name of Capital Programme: Repositories and Preservation Programme</b>			
<b>Bid for Calls :</b> (Please tick ONE BOX ONLY, as appropriate)			
<b>Discovery to Delivery and Interoperability Demonstrators (Strand C)</b>			
	<b>Call I – Interoperability Demonstrators</b>	<input type="checkbox"/> a) Interoperability demonstrators	
<b>Repository Start-Up and Enhancement (Strand D)</b>			
	<b>Call II – Repository Start-Up and Enhancement Projects</b>	<input checked="" type="checkbox"/> a) Repository start-up projects <input type="checkbox"/> b) Repository enhancement projects <input type="checkbox"/> c) Rapid innovation projects: enhancing repository content	
<b>Digital Preservation Across the Lifecycle (Strand H)</b>			
	<b>Call III – Digital Preservation Across the Lifecycle</b>	<input type="checkbox"/> a) Digital preservation across the lifecycle	
<b>Name of Lead Institution:</b> The Open University			
<b>Name of Proposed Project:</b> Mathematics Question Bank			
<b>Name(s) of Project Partner(s):</b>			
<b>Full Contact Details for Primary Contact:</b>			
<b>Name:</b> Dr Ben Mestel			
<b>Position:</b> Senior Lecturer			
<b>Email:</b> B.Mestel@open.ac.uk			
<b>Address:</b> Mathematics Online Project, Department of Mathematics and Statistics, The Open University, Walton Hall, Milton Keynes, Bucks MK7 6AA			
<b>Tel No:</b> 01908 655829			
<b>Fax No:</b> 01908 652140			
<b>Length of Project:</b> 12 months			
<b>Project Start Date:</b> 1 Jan 2008		<b>Project End Date:</b> 31 December 2008	
<b>Total Funding Requested from JISC:</b> £30, 000			

<b>Funding Broken Down over Financial Years (Mar – Apr):</b>		
	<b>Sep07 - Mar08</b>	<b>Apr08 – Mar09</b>
	£7,500	£22,500
<b>Total Institutional Contributions:</b>		
<b>Outline Project Description</b>		
<p>The project will establish a national repository for mathematics e-assessment questions for UK higher education institutions drawing on the experience of different groups and systems currently employed within the UK HE community. The question bank will support multiple-choice, drag-and-drop, free-text, intelligent randomization, computer algebra and other recent development in e-assessment in mathematics and mathematically rich sciences. Based on, and informally supported by, the physical sciences question bank, the mathematics question bank (MQB) will include materials from the full range of undergraduate mathematics assessment, from entry level to final year MMath (Master of Mathematics), where appropriate. It will encompass a full range of pure and applied mathematical topics and also mathematical statistics. It will aim to accommodate a wide range of mathematical e-assessment environments currently in use, including Maple TA, STACK, SToMP, PROMPT, Mathletics, OpenMark, and Moodle. Interoperability between different environments will be a key theme of the project, and the project team will work with the QTI development community to specify enhancements of QTI 2.1 to include computer-algebra question-types.</p> <p>The project will be based at the Open University as part of the Mathematics Online Project (MOL) and will formally comprise 25% FTE of a member of the MOL team as well as a dedicated software developer. Secretarial and other technical support will be provided by the OU Mathematics and Computing Faculty. Liaising with the mathematics computer-algebra e-assessment community (MADCAP) and with the Moodle quiz module global maintenance team (based at the Open University), the project team will work closely with other members of the MOL team as well as with the Mathematics, Statistics and Operational Research Network, the four Open University CETLs and other UK Mathematics CETLs.</p> <p>Over the last five years there has been an exciting growth in e-assessment by committed teams within UK mathematics departments, who are largely working within their own individual software environments, and so their work has yet to be fully integrated into the wider higher education community. The consequence has been that the introduction of e-assessment into mathematics degree programmes has been somewhat slower than one might have forecast. The establishment of a MQB will enable all UK mathematics departments to draw on the expertise and experience of the whole community and will have a significant effect on UK HE mathematics e-assessment.</p>		
<b>I have looked at the example FOI form at Appendix A and included an FOI form in the attached bid (Tick Box)</b>		<b>NO</b>
<b>I have read the Circular and associated Terms and Conditions of Grant at Appendix B (Tick Box)</b>	<b>YES</b>	

### **C. Appropriateness and Fit to Programme Objectives and Overall Value to the JISC Community**

The JISC call specifically includes repository start-up and enhancement projects (paragraphs F27-F44) and this project clearly falls within the scope of the call. The repository is intended as a resource for the whole UK mathematics and scientific community. Its principal users will be UK higher educational institutions and their staff, but its use by pre-university and non-UK institutions and practitioners is envisaged.

### **D. Quality of Proposal and Robustness of Workplan**

#### **Project plan and timetable**

The project plan is to establish an e-assessment mathematics question bank for the use of the UK HE community. The project is intended to run from 1 January 2008 to 31 December 2008, although a part of the project activities will occur outwith this period. The plan is divided into the following phases:

Phase 1. Initial stakeholder consultation, recruitment of software developer. Timetable: October – December 2007

Phase 2. Induction and training of software developer, design and implementation of basic repository shell, collection and deposit of question types, consultation with stakeholders on QTI and interoperability issues. Timetable: January 2008 - June 2008

Phase 3. Development of conversion tools, July 2008 – October 2008

Phase 4. Consolidation of repository, authoring of user guide, dissemination to JISC community, November 2008 – December 2008.

#### **Deliverables**

The following are the principal deliverables for the project.

1. A web-accessible, extendable, searchable, classified repository for mathematics question-types with import/export facilities for the principal systems in current use in the UK. Date expected: July 2008
2. A report on interoperability issues for mathematics e-assessment, including recommendations for QTI enhancements. Date expected: July 2008
3. A suite of conversion tools enabling inter-system import/export of question types. Date expected: November 2008.
4. A user-guide to the repository and conversion tools. Date expected: January 2009.

5. Project report for the JISC community. Date expected: January 2009.

### Project management arrangements

The project will be managed as part of the Mathematics Online Project (<http://www.mcs.open.ac.uk/mol>), which is part of the Faculty of Mathematics and Computing of the University and will be subject to the University's and Faculty's standard project management arrangements.

### Risk assessment

The following major project-specific risks have been identified.

1. The project will be unable to recruit a software developer at the grade or for the time period required.
2. The project will take longer than the 12 months allocated.
3. Insufficient items will be made available for the question bank.
4. It will not be possible to convert efficiently between different systems.
5. The question bank will not be maintained properly after the end of the project.

Of these risks, the first is considered to be the most serious, as any delay in recruitment will hinder considerably the delivery of the project goal to plan.

Risk	Probability (1-5)	Severity (1-5)	Score (P x S)	Action to Prevent/Manage Risk
The project will be unable to recruit a software developer at the grade or for the time period required.	2	4	8	The salary of the software developer has been placed at the postdoctoral research assistant level in order to mitigate this risk and to maximise the chance of attracting a suitable candidate.
The project will take longer than the 12 months allocated.	1	2	3	The project will draw on the experience of Dr Richard Bacon in his work establishing the physical sciences question bank.
Insufficient items will be made available for the question bank.	1	4	4	The Mathematics Online Project will investing in e-assessment which will be included in the MQB. The project is being developed with the involvement of MSOR Network and the MADCAP group.
It will not be possible to convert efficiently between different systems.	3	2	6	The completion of the first two phases will already provide the UK a very valuable resource and that only partial completion of the

				third phase will nevertheless be of use. The system will be designed to extendable and further work will be possible at later stage. The project will be advised by Niall Sclater, co-author of QTI.
The question bank will not be maintained properly after the end of the project.	1	3	3	The MQB will be maintained for at least three years and all efforts will be made to find a permanent home, most likely at the MSOR Network or the Higher Education Academy, as is the case for the physical sciences question bank.

### **IPR position**

It is expected that the majority of items in the repository will be accepted on a free-to-use open-source basis. Contributors wishing to impose specific restrictions on the use and development of their questions may do so after having obtained the approval of JISC and of the project team. The authorship of items will be explicitly acknowledged.

### **Sustainability issues.**

The repository will be actively maintained and developed by the Mathematics Online Project for at least one year beyond the end of the project. Subsequently the repository is expected to self-sustaining. It is expected that a permanent home will be found either at the Open University or at the MSOR Network/Higher Education Academy; in the interim, the question bank will continue to be hosted and maintained by Dr B Mestel for at least three years.

Very recent developments in the standardisation and accessibility of mathematical notation in computers mean that it is now possible and cost efficient to build up online resources for mathematics that will be long lived and will provide a basis for further developments in the online teaching of technical subjects.

### **E. Engagement with the Community**

The stakeholders in this project are (i) the UK HE mathematics community, and, in particular, the MSOR Network; (ii) the groups actively engaged in developing mathematics and statistics e-assessment within UK higher education; (iii) the JISC CETIS assessment community; and (iv) the wider UK scientific and mathematical community including pre-university practitioners.

The project team will work closely with the UK HE mathematics community via the Mathematics, Statistics and Operational Research Network (MSOR Network)

(<http://mathstore.ac.uk>) and with the mathematically-based CETLs. The Mathematics Online Project already has strong links with the Open University CETLs (especially COLMSCT) and with the MSOR Network. MOL also has good contacts with the MADCAP network of groups working computer-algebra based e-assessment in mathematics and will host a meeting of this group in Autumn 2007. The project will be advised by Dr Richard Bacon of the University of Surrey on QTI and other matters, and input will be sought from the wider QTI development community. It is intended to disseminate the results of the project widely through the Heads of Departments of Mathematics, the learned societies (such as the Institute of Mathematics and its Applications, the Royal Statistical Society, and the Edinburgh and London Mathematical Societies), the Mathematical Association, the Association of Teachers of Mathematics as well through normal JISC channels.

Since its inception, the Open University has been in the forefront of the use of computer-based assessment in mathematics. Recently the Open University has adopted the open-source Moodle as its VLE and is energetically developing Moodle's functionality on several fronts, including e-assessment. In particular, Tim Hunt (OU) has taken over from Gustav Delius (York) as the global maintainer of the Moodle Quiz Module. The OU's Moodle Quiz Module development team, led by Phil Butcher and Tim Hunt, have now successfully integrated OpenMark, the OU's open-source bespoke e-assessment tool, into the quiz module, as well as enhancing significantly the module's inter-question navigation. It is hoped to include the computer-algebra based STACK system within the next year as well port the Mathematics package to OpenMark. These developments will significantly increase the utility of the Mathematics Question Bank, and the project team will work in tandem with the Moodle quiz module developers.

## F. Budget

Budget (See Appendix A for details)

[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]

JISC: 28%, Open University: 72%

In common with many other UK HEIs, the Open University (as lead institution) is likely to derive significant benefit from the establishment of a Mathematics e-assessment question repository. In particular, the Open University hopes to adapt questions deposited in the Mathematics Question Bank repository for use in its Moodle-based VLE.

## **G. Previous Experience of the Project Team**

The members of the project team are:

Dr Ben Mestel. Ben is a senior lecturer in mathematics at the Open University and heads the Mathematics Online Project. He joined the OU in December 2006 having been Head of Mathematics and Statistics and senior lecturer at the University of Stirling. He had previously been lecturer in mathematics at Exeter for over ten years. Ben will be contributing 25% of his time to the Mathematics Question Bank project during the project year. His role will be twofold. Firstly, he will manage the project, providing academic leadership and advice to the project, with the JISC community, the UK Mathematics community (especially those involved in e-assessment development work) and with the Physics e-assessment question bank. Secondly he will work with Dr Richard Bacon, the UK Madcap computer-algebra mathematics e-assessment group, and the QTI development community to advise on extension to the QTI standard to incorporate computer-algebra and other features required for mathematics e-assessment.

Software developer. The project money will be utilised to employ a software developer for 12 months to work on the project. The developer will require appropriate programming and database expertise and experience, but need not be a computer professional. Indeed, mathematical knowledge and/or experience of e-assessment will be distinct advantages for the appointee. This post will be advertised.

The project will draw on the experience of the Mathematics Online Project team, as well as that of Dr Richard Bacon of the University of Surrey, who heads the analogous physical sciences question bank project.

In addition, the project will be advised by Niall Sclater, Director of the Open University's Virtual Learning Environment Programme and former Head of e-Learning and Assistant Director of Learning Services at the University of Strathclyde. Niall co-wrote the IMS Question and Test Interoperability Specification and was funded by CEN/ISSS to adapt the US-based Schools Interoperability Framework to a European context. He is on the Advisory Committee of the International CAA conference and has published widely in the field of e-learning and e-assessment.

## **H. Supporting Letter(s)**

See next page



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20 June 2007

Dear Sir/Madam

**JISC CIRCULAR 01/07: Repositories and Preservation Calls**

I have pleasure in confirming institutional support for The Open University's Mathematics Question Bank bid to the JISC call: circular 01/07 under Repositories and Preservations Calls, Repository Start-Up and Enhancement (Strand D).

The Open University has been in the forefront of developments in computer-based assessment in Mathematics for over 30 years, and the Mathematics Question Bank will help the OU (and the whole UK higher education community) to take advantage of the recent innovations in computer-algebra based e-assessment in Mathematics.

As part of the OU's e-learning strategy, the University has recently established the Mathematics Online Project (MOL) in the Faculty of Mathematics & Computing with the Centre for Open Learning in Mathematics, Science, Computing and Technology (COLMSCT), an OU CETL. The remit of the Mathematics Online Project is to develop and support both infrastructure and content for online learning and teaching of mathematical material at degree and postgraduate level. The Mathematics Question Bank project will be an important strand of the work of the MOL project over the next eighteen months.

As a part of its investment in the open-source Moodle Virtual Learning Environment, the Open University is taking the lead in the development of the Moodle quiz module.

The University's OpenLearn initiative has made freely available on the web high-quality OU teaching materials. The Mathematics Question Bank is a further example of the OU's commitment to the global knowledge transfer agenda.

Yours faithfully

**DR PAUL CLARK,**  
**Pro-Vice-Chancellor (Learning and Teaching)**

## Appendix A Budget

<b>Directly Incurred Staff</b>	<b>April 07– March 08</b>	<b>April 08– March 09</b>	<b>TOTAL £</b>
████████████████████	████	████	████
██████████			
████████████████████	████	████	████
<b>Non-Staff</b>	<b>April 07– March 08</b>	<b>April 08– March 09</b>	<b>TOTAL £</b>
Travel and expenses	£1000	£1000	£2000
Hardware/software	£2000	£	£2000
Dissemination	£	£	£
Evaluation	£	£	£
Other	£	£	£
<b>Total Directly Incurred Non-Staff (B)</b>	<b>£3000</b>	<b>£1000</b>	<b>£4000</b>
<b>Directly Incurred Total (A+B=C) (C)</b>	<b>£11158</b>	<b>£25475</b>	<b>£36633</b>
<b>Directly Allocated</b>	<b>April 07– March 08</b>	<b>April 08– March 09</b>	<b>TOTAL £</b>
████	████	████	████
Estates	£1719	£5156	£6875
Other	£	£	£
<b>Directly Allocated Total (D)</b>	<b>£5576</b>	<b>£16726</b>	<b>£22302</b>
<b>Indirect Costs (E)</b>	<b>£12031</b>	<b>£36094</b>	<b>£48125</b>
<b>Total Project Cost (C+D+E)</b>	<b>£28765</b>	<b>£78295</b>	<b>£107060</b>
<b>Amount Requested from JISC</b>	<b>£7500</b>	<b>£22500</b>	<b>£30000</b>

<b>Institutional Contributions</b>	<b>£21265</b>	<b>£55795</b>	<b>£77060</b>
<b>Percentage Contributions over the life of the project</b>	<b>JISC 28 %</b>	<b>Partners 72 %</b>	<b>Total 100%</b>

**Table Demonstrating Nature of Institutional Contributions**

<b>Directly Incurred Staff</b>	<b>April 07– March 08</b>	<b>April 08– March 09</b>	<b>TOTAL £</b>
████████████████████ ██████████	████	████	████
<b>Directly Incurred Non Staff</b>			
Hardware/Software etc.	£3000	£1000	£4000
<b>Directly Allocated</b>			
Staff, Estates etc.	£5576	£16726	£22302
<b>Indirect Costs</b>			
Indirect Costs	£12031	£36094	£48125
<b>Total Institutional Contributions</b>	<b>£21265</b>	<b>£55795</b>	<b>£77060</b>