Streamlining the Examination Process

A Toolkit for the Production of Examination Papers with Solutions

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Assessment Methods

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Course work

Laboratory work

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Assessment by examination carries the highest weight

The Examination Paper Production Process

1. Demanding in academic time
2. Rigourous administrative timetable to follow
3. Clashes with teaching commitments in semesters 1 and 2.
4. Issues of quality and rigour
5. Moderated by external examiner

Examination Papers requiring Solutions

1 Necessary to complement the examination paper with detailed numerical solutions.

2 Under pressure of time it is easy to make mistakes or to introduce unrealistic of impractical values when choosing data at random.

Can the process be simplified embracing technology?

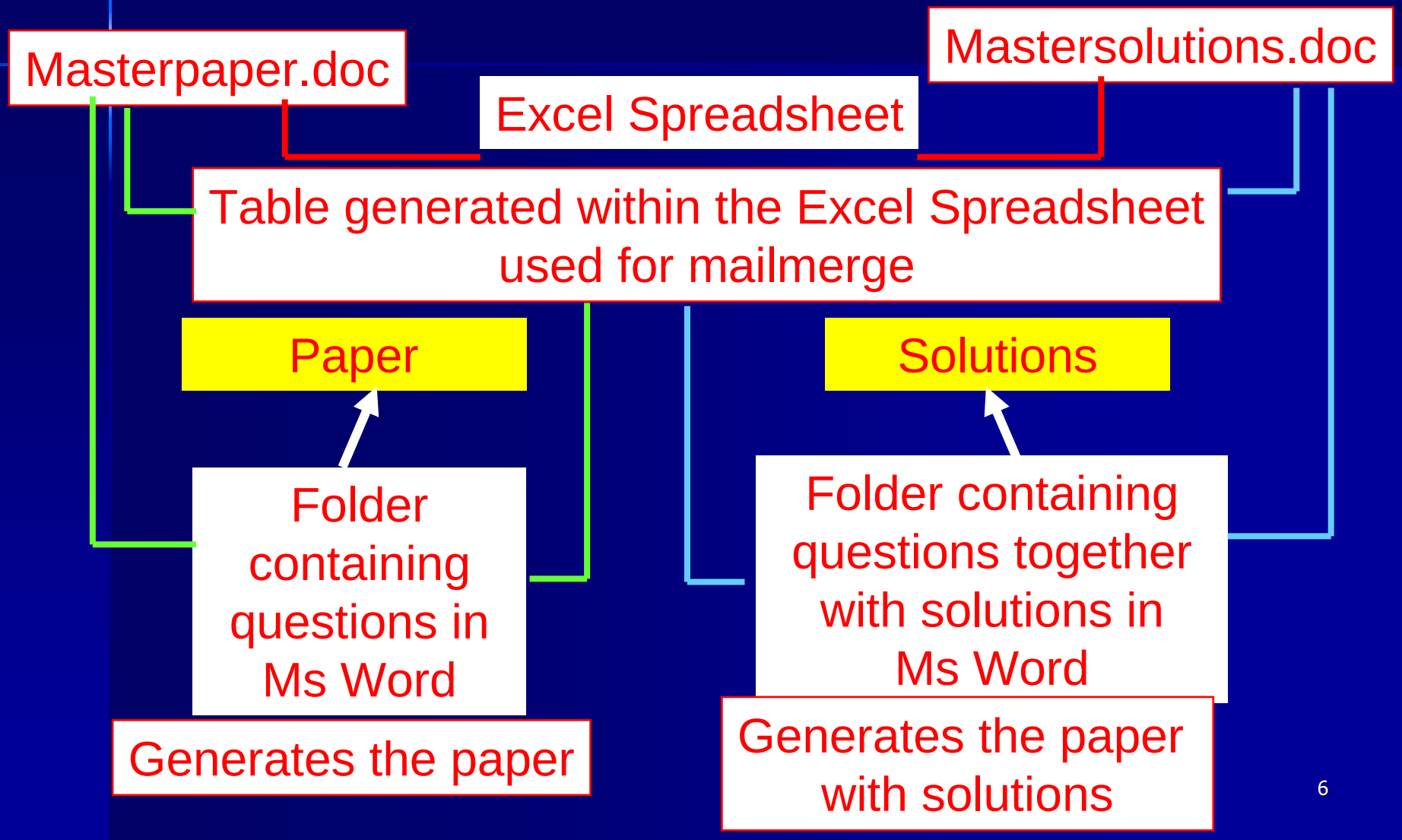
Minimum requirements

The ability to change the question data

The ability to change the order that questions/topics appear in the paper.

The ability to generate the solutions

Method Adopted



Paper and Solutions Folders

1 Holds a set of questions labelled QuestionA, QuestionB, QuestionC…..etc

2 The question files in the solutions directory contain both the question and step by step solutions.

3 All the variables in questionA are prefixed by A, all those in Question B by B, all those in questionC by C….etc

4 Each question is linked to the Excel Spreadsheet through a worksheet labelled sheetA, sheetB, sheetC ….etc with corresponding tables, TableA, Table B, TableC … etc.

Example Question F Paper Folder

Question number supplied from the Excel spreadsheet

«F»	(i)	State the relationship between total pressure, static pressure, dynamic pressure and hydrostatic pressure. For a gas flow distinguish clearly between stagnation pressure and static pressure. ***(4 marks)***
	(ii)	A jet of water issues vertically from a circular fountain head into the atmosphere and rises to a maximum height of «Fheight1» m. Determine the velocity of the water as it leaves the fountain. ***(3 marks)***
	(iii)	If the fountain head has a diameter of «Fdiameter» cm, calculate the mass flow rate of the water in the jet. ***(2 marks)***
	(iv)	Due to system changes the mass flow rate of the water now changes to «Fmassflowrate2» kg/s, determine the maximum height above the fountain head the water now reaches and also determine the velocity of the water at a height «Fheight2» m above the fountain head. ***(5 marks)***
	(v)	A flat plate is now placed horizontally into the jet of water, «Fheight3» metres above the fountain head, as shown in figure. Sketch a suitable control volume and hence determine the vertical force which must be

The numerical data is supplied as a merge field enabling the data to be easily changed.

The merge fields come from TableF on SheetF of the Excel spreadsheet

Merge fields come from TableF on SheetF of the Excel spreadsheet

Question F utions Directory

	(ii)	A jet of water issues vertically from a circular fountain head into the atmosphere and rises to a maximum height of «Fheight1» m. Determine the velocity of the water as it leaves the fountain. ***(3 marks)***
	(iii)	*Using Bernoulli's eqn:* $P_1 + \frac{1}{2}\rho V_1^2 + \rho g z_1 = P_2 + \frac{1}{2}\rho V_2^2 + \rho g z_2$ $P_1 = P_2 =$ *atmospheric pressure,* $V_2 = 0$, $z_1 = 0$ *gives:* $V_1 = \sqrt{2g(z_2 - z_1)}$ = sqrt(2*9.81*«Fheight1»)=«Fvel1»m/s *(3 marks)*
	(iii)	If the fountain head has a diameter of «Fdiameter» cm, calculate the mass flow rate of the water in the jet. ***(2 marks)***
	(iv)	$\dot{m} = \rho AV = 1000 \times$ («Fdiameter»/100)$^2 \times \pi/4 \times$ «Fvel1» = «Fmassflowrate1» kg/s. *(2 marks)*

Question

Solution

Question

Solution

SheetF of Spreadheet

Cell A5 topic

Each question can be generated separately; QuestionF is mailmerged with TableF

TableF

F	Fheight1	Fdiamete	Fmassflov	Fheight2	Fvel1	Farea	Fmassflov	Fvel2	Fmaxh	Fvel3	FForce	Ftotalnumbe
6	20	35	1800	10	19.809	0.096	1905.858	18.709	17.840	12.402	-22.324	13

MomentumandBernoullisequation

F	6		min	max	ndp	nscale
Fheight1	20.00		3	5	0	5
Fdiameter	35.00		6	7	0	5
Fmassflowrate2	1800.00		15	25	0	100
Fheight2	10.00					
Fvel1	19.80908882					
Farea	0.096211275					
Fmassflowrate1	1905.857693					
Fvel2	18.70882596					
Fmaxh	17.83996784					
Fvel3	12.40242593					
FForce	-22.32436667					
Ftotalnumber	13					

Data information

Data variables for the question

Calculated steps in the solution produced using formulae linking the named data variables

Total number of variables

Data generated using a random number generator ROUND(RAND()*(max-min)+min,ndp)*nscale

Output rounded to fix the number of decimal places

The Paper Design

1 Starts with the topics on the module syllabus.

2 Contains a number of questions.

Example

Need to generate a paper containing 5 questions from a syllabus with 5 topics.

There are 25 different ways that the paper could be produced.

The Analysis Sheet of the Excel Spreadsheet

1. Collates the information in cell A5 on sheetA, sheetB …etc and sorts them into the syllabus topics.
2. Sorts out which of the questions relates to each topic.
3. Chooses a random mix of 5 questions with one question from each topic.
4. Makes a random choice of question layout to vary the position of the question within the paper i.e. one of the 25 possible arrangements.
5. Generates a table called Tablemaster which provides the merge fields needed to generate the paper and the paper with the solutions.
6. Steps 1-5 are executed automatically.

Goal to generate a paper with 5 questions from 5 topics

The Excel Spreadsheet Analysis Sheet

Module

1	Fluid Mechanics	Ary1	Ary2	Ary3	Ary4	Ary5
2	Ary1	topic1	topic5	topic4	topic3	topic2
3	Ary2	topic2	topic1	topic5	topic4	topic3
4	Ary3	topic3	topic2	topic1	topic5	topic4
5	Ary4	topic4	topic3	topic2	topic1	topic5
6	Ary5	topic5	topic4	topic3	topic2	topic1
7						
8						
9	O:/fluids/generation/new method/solutions/	O:/fluids/generation/n	generation12.xls!		E1.2 2009/2010	

Folder holding Questions with solutions

Folder holding Questions

Paper information

Number of different questions on each topic

20	nchoice								
21		4							
22									
23	Syllabus Structure				Questions Related to Each Topic				
24				1		2		3	
25	Topic1	Dimensionalanalysis	Topic1	E	5	I	9	Q	
26	Topic2	Hydrostatics	Topic2	B	2	G	7	S	
27	Topic3	FlowinPipes	Topic3	C	3	M	13	T	
28	Topic4	SubmergedSurfaces	Topic4	A	1	H	8	N	
29	Topic5	MomentumandBernou	Topic5	D	4	F	6	J	

Module topics

Question Analysis

N	O	P	Q	R	S
1	SubmergedSurfaces	A	Topic4	A	Topic4
2	Hydrostatics	B	Topic2	B	Topic2
3	FlowinPipes	C	Topic3	C	Topic3
4	MomentumandBernoullisEquation	D	Topic5	D	Topic5
5	Dimensionalanalysis	E	Topic1	E	Topic1
6	MomentumandBernoullisequation	F	Topic5	F	Topic5
7	Hydrostatics	G	Topic2	G	Topic2
8	Submergedsurfaces	H	Topic4	H	Topic4
9	Dimensionalanalysis	I	Topic1		
10	MomentumandBernoullisEquation	J	Topic5		
11	MomentumandBernoullisequation	K	Topic5		
12	MomentumandBernoullisequation	L	Topic5	L	Topic5
13	FlowinPipes	M	Topic3	M	Topic3
14	SubmergedSurfaces	N	Topic4	N	Topic4
15	MomentumandBernoullisequation	O	Topic5	O	Topic5
16					
17					
18					
19					
20					
21					
22	Submergedsurfaces	V	Topic4	V	Topic4
23	Hydrostatics	W	Topic2	W	Topic2
24	Flowinpipes	X	Topic3	X	Topic3

SORTED INTO TOPICS

INFORMATION COLLECTED FROM CELL B5 OF WORKSHEETS SheetA, SheetB….. etc

Sorting the Questions

Number of different questions on each topic

20	nchoice											
21	4											
22												
23	Syllabus Structure				Questions Related to Each Topic							
24					1		2		3		4	
25	Topic1	Dimensionalanalysis	Topic1	E	5	I	9	Q	17	R		
26	Topic2	Hydrostatics	Topic2	B	2	G	7	S	19	W		
27	Topic3	FlowinPipes	Topic3	C	3	M	13	T	20	X		
28	Topic4	SubmergedSurfaces	Topic4	A	1	H	8	N	14	V		
29	Topic5	MomentumandBernoullisE	Topic5	D	4	F	6	J	10	K		
30												
31												

QUESTIONS SORTED INTO TOPICS

Choosing the Question Arrangement

	Random Choice of Questions on Each Topic										
Topic1	I	R	R	Q	I	Q	I	1			
Topic2	S	W	S	B	B	G	W	2			
Topic3	T	M	T	M	M	T	T	3			
Topic4	V	H	H	A	H	H	V	4			
Topic5	J	J	F	K	J	D	F	5			
1	Random Choice of Questions for Arx1					2					
Arx1	1	2	3	4	5	Arx2	1	2	3	4	
topic1	I	R	R	Q	I	topic5	J	J	F	K	J
topic2	S	W	S	B	B	topic1	I	R	R	Q	I
topic3	T	M	T	M	M	topic2	S	W	S	B	B
topic4	V	H	H	A	H	topic3	T	M	T	M	M
topic5	J	J	F	K	J	topic4	V	H	H	A	H
Selected Arrangement		Choice of Questions									
Ary2		3									
1	topic2	S	1	sheetS	17	QuestionS					
2	topic1	R	2	sheetR	23	QuestionR					
3	topic5	F	3	sheetF	13	QuestionF					
4	topic4	H	4	sheetH	28	QuestionH					
5	topic3	T	5	sheetT	15	QuestionT					

Demonstration

Producing the Merge Table

Question1	S	Satm	Sheight1	Sheight2	Sheight3	Sheight4	Srho1	Srho2	Srho3	Satp	Spre
17	1	752.39	41.8	432.6	253.2	189.6	1000	764.2	1000	100380.9	806
Question2	R	Rheightd	Rheightp	Rdia	Rlength	rlength2	Rff	Red	Rarea	Rvel1	RQ
40	2	5.6	1.57	1.23	779.8	338.6	0.02	0.03	1.188229	2.429353	2.8
Question3	F	Fheight1	Fdiameter	Fmassflo	Fheight2	Fvel1	Farea	Fmassflowr	Fvel2	Fmaxh	Fvel
53	3	15	30	2000	10	17.1552	0.07068583	1212.6278	28.29421	40.80339	24.5
Question4	H	Harea	Hsg	Hpa	Hheight	Hpressur	Hlength	Hbreadth	Hdepth2	Hdepth3	Hder
81	4	3.2	0.82	101.72	4.1	119	2	1.1	27	11.25	
Question5	T	Trho	Tdia	Tdynv	Tlength	TV	Tkdynv	Tmaxv	Tre	Tf	TA
96	5	835	0.3	7.79	1.74	0.2	9.3293E-06	0.0621956	6431.322	0.035331	0.0

Headerp	filep1	filep2	filep3	filep4	filep5	Appendix	Headers	files1	files2	files3	files4
O:/fluids/generation/new method/pap	O:/fluids/generation/new r	O:/fluids/gene	O:/fluids/g	O:/fluids/	O:/fluids/g	O:/fluids/	O:/fluids/gen	O:/fluids/ge	O:/fluids/g	O:/fluids/g	O:/flu
O:/fluids/generation/new method/pap	O:/fluids/generation/new r	O:/fluids/gene	O:/fluids/g	O:/fluids/	O:/fluids/g	O:/fluids/	O:/fluids/gen	O:/fluids/ge	O:/fluids/g	O:/fluids/g	O:/flu

Tablemaster

Files needed to generate paper

Files needed to generate paper together with the solutions

Producing the Paper and paper with solutions

1 To generate the examination paper Mailmerge is executed using the Masterpaper.doc file with the merge fields coming from table Tablemaster on the Excel spreadsheet

2 To generate the examination paper with solutions Mailmerge is executed using the Mastersolutions.doc file with the merge fields coming from table Tablemaster on the Excel spreadsheet

Master paper.doc
Mastersolutions.doc

The merge fields are supplied from the Tablemaster table on the Analysis sheet of the Excel spreadsheet

{includetext "{ MERGEFIELD "Headerp" }" }
{includetext "{ MERGEFIELD "filep1" }" }
{includetext "{ MERGEFIELD "filep2" }" }
{includetext "{ MERGEFIELD "filep3" }" }
{includetext "{ MERGEFIELD "filep4" }" }
{includetext "{ MERGEFIELD "filep5" }" }
{includetext "{ MERGEFIELD "Appendixp" }" }

Masterpaper.doc

{includetext "{ MERGEFIELD "Headers" }" }
{includetext "{ MERGEFIELD "files1" }" }
{includetext "{ MERGEFIELD "files2" }" }
{includetext "{ MERGEFIELD "files3" }" }
{includetext "{ MERGEFIELD "files4" }" }
{includetext "{ MERGEFIELD "files5" }" }
{includetext "{ MERGEFIELD "Appendixs" }" }

Mastersolutions.doc

Either word file is opened and the mailmerge executed to generate either the paper or the paper with the solutions

Demonstration

Excel Spreadsheet Paper Sheet

Examination Paper Fluid MechanicsE1.2 2009/2010													
Question1	Dimensionalanalysis	Q	Qdiam	Qdiap	QNm	QUP	Qrhom	Qrhop	Qdynvm	Qdynvp	Qpm	QNp	QPp
Topic1		1	41	185.2	76	47	1000	1.2	1.14	1.73	110	47.10417	59.1
Question2	MomentumandBernoullisEqua	D	dsg	dmassflo	Dgaugep1	Ddia1	Ddia2	dangle	Darea1	Darea2	Ddensity	Dvel1	Dvel2
Topic5		2	0.81	2450	25	0.37	0.22	30	0.107521	0.038013	810	28.13117	79.5
Question3	SubmergedSurfaces	N	Nlength	Nbreadth	Ndensity	Ndepth	Ndistance	Nangle	NG	Nhc	Npressure	Narea	NFor
Topic4		3	2.1	1.1	850	25	10	45	800	17.5	145.9238	2.31	337.
Question4	FlowinPipes	M	Msg	Mdynv	Mdia	Mvdot	MnewV	Mlengthp	Mangle	Me	Mdensity	Marea	MV
Topic3		4	0.82	0.001	0.32	95	160	5	45	5	820	0.080425	1.18
Question5	Hydrostatics	G	Gheight	Gsg	Gforce	Gareasma	Garealarge	Grho	Gheight2	Gmass	Gatp	Gatpbar	Gpres
Topic2		5	755.23	13.6	11300	135	645	780	16	4600	100759.8	1.007598	83

The Paper sheet in the Excel spreadsheet gives a record of the questions selected and the values selected for the question data.

Conclusions

1. A method of generating examination papers complete with solutions has been demonstrated harnessing features of Ms Word and Excel linked through mailmerge.
2. The method gives scope to free up the amount of academic time needed to produce both examination papers and the solutions. Examination paper production could become a non-academic function (though academic time would be needed to produce the question sets and lay out the solutions).
3. The method ensures that the paper produced gives full coverage of the module syllabus.
4. The method can be easily adapted to other subjects and modules

Attractive Features

1 The questions selected can be automatically varied.

2 The numerical data in questions is automatically varied within the ranges specified.

3 The solutions to questions can be produced.

4 The same Excel spreadsheet can be used for every paper.

5 The method can be used by someone with only a knowledge of Ms Word.