Revision to the

Mathematics Flexible Pre-Major Requirements

Report to the BCcupms

May 2011

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Background

At the Simon Fraser University meeting of the BCcupms in May 2010, discussion concerning the *Mathematics Flexible Pre-Major* (MFP-M) led to the following action item:

Action: David Leeming and Leo Neufeld (original members of the Mathematics Flexible Pre-Major Subcommittee) will make the suggested changes to the programme requirements, get approval from receiving institutions, and bring the revision back to the meeting next year for ratification.

The "suggested changes" were to exchange the Introductory Analysis (IA) course, now listed with the CORE courses, with the Ordinary Differential Equations (ODE) course, presently ranked as an ADDITIONAL course. Following this, a response to this "suggested" change to the MFP-M was to be elicited from universities named in the MFP-M.

Action

The requested "suggested changes" were made and sent for comment to representatives of the receiving institutions named in the *Mathematics Flexible Pre-Major*.

A <u>brief</u> summary of the comments and suggestions offered by respondents follows:

SFU – See no difficulty – many sending institutions can't offer IA – 3rd year not closed without IA.
UBC(V) – their listed IA is a "proofs" course – transfer may have to be re-visited in any case.
UBC(O) – have "proofs" course in 2nd year, but do a full IA course in 3rd year.
TRU – prefer the original Core – why put a less required course in the Core?
TWU – have moved IA to 3rd year.
UFV – students would be better off with the original Core.
UNBC – poses no serious problem for transferring students.
UVic – have made some program changes – "suggested" Core will cost students extra time.

Since 2008, some institutions have made course-numbering changes and/or modified the course requirements for their Mathematics Major program. These changes are reflected in the following MFP-M course listing, schematic and requirements table.

Respondents from Receiving Institutions

Dr. Ladislav Stacho Simon Fraser University	Dr. Wayne Nagata and Dr. Rajiv Gupta The University of British Columbia (Vancouver)
Dr. Qiduan Yang The University of British Columbia (Okanagan)	Dr. Shane Rollans Thompson Rivers University
Dr. Rick Sutcliffe Trinity Western University	Dr. Greg Schlitt University of the Fraser Valley
Dr. Jennifer Hyndman University of Northern British Columbia	Dr. Gary MacGillivray University of Victoria

Acknowledgment

Gratitude is extended to each of those who responded to the request for comment on the "suggested changes" to the *Mathematics Flexible Pre-Major*.

Mathematics Flexible Pre-Major Program

For a college student wishing to proceed to the upper division of a Bachelor of Science Major in Mathematics program at a British Columbia university, the suggested Core courses and Additional courses that can be chosen to comprise a Mathematics Flexible Pre-Major program are listed below. This information may also prove useful to Sending institutions desiring to support the design of a Mathematics Flexible Pre-Major program. The schematic on the next page shows how this program fits into the specific Mathematics Major requirements at eight BC post-secondary institutions.

CORE Mathematics and Computer Science Courses

Calculus I, II, III
Linear Algebra
Discrete Mathematics I
Ordinary Differential Equations
Computer Science I, II

ADDITIONAL Mathematics, Statistics and Computer Science Courses

Introduction to Real Analysis
Statistics I
Discrete Mathematics II
Foundations of Modern Mathematics
Transition to Advanced Mathematics
Abstract Algebra
Statistics II

CORE English and Science Courses

English I, II
Lab-based Chemistry I
Lab-based Physics I, II

ADDITIONAL Science Courses

Lab-based Chemistry II
Biology

Core Courses are those required by 6 or more of the surveyed Receiving institutions in their Mathematics Major programs and can be considered a 'must' in any Mathematics Flexible Pre-Major program. The Additional Courses are requirements at five or fewer Receiving institutions. While Sending institutions might wish to design a Mathematics Flexible Pre-Major program satisfying local needs, students, who are intent on moving to a particular institution at which to complete their upper division courses, would be wise to choose courses satisfying the requirements at that institution.

Post-Secondary Institutions in British Columbia
and the Mathematics Flexible Pre-Major

This schematic lists by course number those <u>Additional</u> Mathematics, Statistics and Computer Science courses beyond the <u>Core</u> courses that are required at each of the BC Receiving institutions indicated. The course numbers at respective Receiving institutions are in parentheses.

<u>Recommended CORE plus ADDITIONAL Courses at Each Receiving Institution</u>		
<u>UBC(V) Additional</u> Mathematical Proof (220) Computer Science [Confirm that Core CPSC courses transfer to UBC]	**<u>UBC(O) Additional</u>** Mathematical Proof (220) Statistics I (230)	**<u>SFU Additional</u>** Introduction to Analysis (242) Discrete Mathematics II (201) Statistics I (270) Computing with Algebra (203) Computing with Calculus (204)
<u>UFV Additional</u> Statistics I (270) Transition to Adv. Math (265)	**<u>CORE Courses</u>** **Calculus I, II, III** **Linear Algebra** **Discrete Mathematics I** **Ordinary Differential Equations** **Computer Science I, II**	**<u>UVic Additional</u>** Intro to Real Analysis (236) Abstract Algebra (212) Discrete Mathematics II (222) Statistics I (260) Statistics II (261)
<u>TWU Additional</u>	**<u>TRU Additional</u>** Introduction to Analysis (2200) Statistics I (2000) Discrete Mathematics II (2700)	**<u>UNBC Additional</u>** Intro to Complex Analysis (201) Found. Modern Math (224)

While the courses indicated above are sufficient to meet program requirements at the referenced institutions, it should be noted that, at some institutions, program flexibility permits a slight variation in the choice of courses as listed. Students are strongly advised to consult on-line calendars or to contact departmental advisors at their chosen institution to obtain further information about alternate course options or about any 'strongly recommended' courses in this particular Mathematics Major program.

Mathematics, Statistics and Computer Science Requirements in Mathematics Major Programs At British Columbia Post-Secondary Institutions

Math Major Requirements	UBC(V)	UBC(O)	SFU		UVic	UNBC	TRU	TWU	UFV	Freq.
1st Year										
Calculus I	MATH 100	MATH 100	MATH 150 or 151		MATH 100	MATH 100	MATH 1140	MATH 123	MATH 111	8
Calculus II	MATH 101	MATH 101	MATH 152		MATH 101	MATH 101	MATH 1240	MATH 124	MATH 112	8
Discrete Math I			MACM 101		MATH 122	CPSC 141	MATH 1700	MATH 150		5
Comp Science	CPSC 110	COSC 111	CMPT 120	CMPT 126	CSC 110	CPSC 100	COMP 1130	CMPT 140	COMP 152	8
Comp Science		COSC 121	CMPT 125		CSC 115		COMP 1230	CMPT 166		5/4
2nd Year										
Calculus III	MATH 200	MATH 200	MATH 251		MATH 200	MATH 200	MATH 2110	MATH 223	MATH 211	8
Diff Equations	MATH 215	MATH 225	MATH 310		MATH 201	MATH 230			MATH 255	6
Linear Alg	MATH 221	MATH 221	MATH 240		MATH 211	MATH 220	MATH 2120	MATH 250	MATH 221	8
Intro Analysis/ Proofs Course	MATH 220	MATH 220	MATH 242		MATH 236	MATH 224	MATH 2200		MATH 265	7
Discrete Math II		COSC 221	MACM 201		MATH 222		MATH 2700		MATH 225	5
Intro Complex Analysis						MATH 201				1
Abstract Alg					MATH 212					1
Comp w/Alg			MACM 203							1
Comp w/Calc			MACM 204							1
Statistics I		STAT 230	STAT 270		STAT 260		STAT 2000		MATH 270	5
Statistics II					STAT 261					1
Comp Science	CPSC 210									1
Course Totals										
Mathematics	6	6	9		9	7	7	5	7	
Statistics	0	1	1		2	0	1	0	1	
Comp Science	2	3	2/1		2	2	2	2	1	
Total	**8**	**10**	**13/12**		**13**	**9**	**10**	**7**	**9**	

Appendix

<u>Verbatim Responses from Receiving Institutions</u>

Note that some institutions revealed course requirement adjustments to their Mathematics Major programs in their responses to the "suggested changes". These adjustments were not available to other respondents.

Simon Fraser University – Ladislav Stacho

1. I do not see a problem with moving the ODE's course to CORE courses and Intro to Analysis to ADDITIONAL courses. Many sending institutions do not offer an Intro to Analysis course and this would allow them more flexibility in offering a pre-major program.

2. While we require Intro to Analysis for approval into the Math Major, students who have completed a flexible pre-major without it will not have obstacles in front of them if they want to take our upper-division math courses.

3. We encourage students who have not taken an Intro to Analysis course as part of their pre-major to complete it as soon as possible when they arrive at SFU. We offer this course once per year (currently in Fall semester).

4. MACM 202 (4 credits) has been replaced with MACM 203 (2 credits) and MACM 204 (2 credits). This should be reflected in the draft and also thought of for transfer credits.

The University of British Columbia (V) – Wayne Nagata and Rajiv Gupta

At UBC (Vancouver) a B.Sc. Math major and a B.A. Math major both require both "ODE" and "Intro Analysis" (actually called "Mathematical Proof", UBC MATH 220). The latter course is in the process of being revamped, I don't know if it will transfer anymore to "Intro Analysis" (there will hardly be any analysis in UBC MATH 220).

Indeed UBC MATH 220 hardly has any analysis now, and that may affect its transfer status. My colleague Andrew Rechnitzer, copied here, has been the faculty member overseeing MATH 220's transition and can provide you with any further required information and help you assess the implications for transfer.

The University of British Columbia (O) – Qiduan Yang

I read the Flexible Pre-Major program and I am very happy with the course requirement. The program is basically the same with UBCO first two years requirement, although I feel that the course load in this program is quite heavy. We put the introductory Analysis and Abstract Algebra in the 3rd year level, after the course "Mathematical Proof" is taken by the students (I believe that UBC has been doing the same).

Thompson Rivers University – Shane Rollans

I am unclear as to why you are adding ODEs (required by 5 schools) to the core when it does not meet your definition of core and removing Intro to Analysis (required by 7 schools) which does. Obviously we prefer the original core since we do not require ODEs for our program but we do require Intro to Analysis.

If you make the change, you need to revise your definition of core.

Trinity Western University – Rick Sutcliffe

We have made some changes at TWU. Intro Discrete is now 150 and required for majors and concentrations. Analysis has been changed from 220 to "Analysis and Topology", a third year course, 323, worth 4 credits rather than three. Computing science I is now 140 and #2 is now 166.

Appendix (Continued)

University of the Fraser Valley – Greg Schlitt

From our perspective, (or rather from the perspective of students transferring to our program), it would be better to have the ODEs as ADDITIONAL and Introduction to Real Analysis as CORE.

Rationale: In our major program students have the option of either Discrete Math (our 225) OR ODEs (our 255), and must have our 265 (Transition to Advanced Mathematics). We could likely give credit for our 265 to someone coming with an introduction to analysis course. So students coming with the "old" core in place (assuming their Discrete Math transferred to our 225) would be further ahead.

University of Northern British Columbia – Jennifer Hyndman

With respect to the swapping of the ODE and Intro Analysis: This works for us as we don't really have a lower level Introductory Real Analysis. Some is done in MATH 224 Foundations of Modern Math and some in MATH 201, which is Intro to Complex.

A correction for your table is that MATH 226 Advanced Linear Algebra has been turned into MATH 326 Advanced Linear Algebra so there is only one linear algebra course in the first two years at UNBC.

University of Victoria – Gary MacGillivray

From the perspective of our program the proposed switch will probably cost the students time. ODEs is offered every term, including summer, whereas Intro Analysis is a Jan - Apr term class only. The lack of Intro Analysis means they'd need to wait to move on in the pure math sequence. Since there are 3rd year prerequisites for some of the courses too, that would rule out a lot of possible topics as part of a 4-year degree. It would also rule out Math Honours unless the student took a fifth year.

There are some other issues as well. Of the proposed Additional Courses:

Introduction to Real Analysis   --- Spring term only
Statistics I --- Both Fall and Spring terms, but Stat II is required, and is Spring Term only
Discrete Mathematics II -- Every term including Summer
Mathematical Modelling --- not a second year course at UVic
Foundations of Modern Mathematics --- The UVic version is what you're calling DM I
Abstract Algebra --- offered in the Spring, and possible Summer
Statistics II --- Spring Term only
Operations Research --- not a second year course at UVic

It seems that a student coming in with just the core could move on only in Discrete Math and (some) Applied Math. Most of Pure Math and Stats would be out of reach for a year. Without the switch, the student could still move on in these areas, and would be able to move on in topics of Pure Math with the exclusion of Algebra.