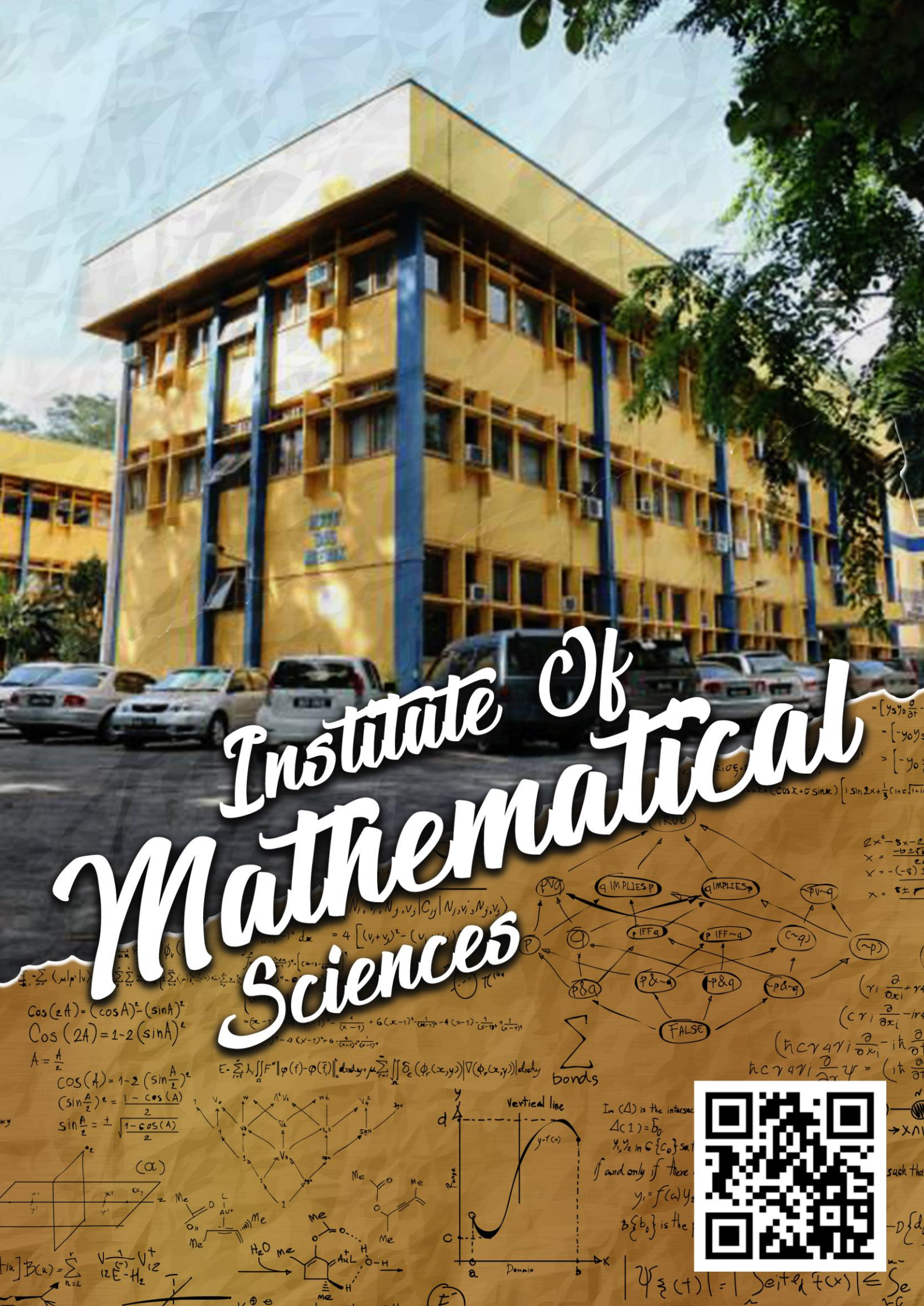
Institute Of
Mathematical
Sciences

BACHELOR OF SCIENCE IN MATHEMATICS SESSION 2019/2020 (125 CREDITS)			
1. UNIVERSITY COURSES (20 CREDITS)			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
GLTxxxx	Communication in English	-	6
GKN/GKR/GKV	Co-curriculum	-	2
GIG1001/ GLT1017	The Islamic and Asian Civilization (TITAS)/ Basic Malay Language (only for international students)	-	2
GIG1002/ GIG1006	Ethnic Relations/ Introduction to Malaysia (only for international stufdents)	-	2
GIG1003	Basic Entrepreneurship Culture	-	2
GIG1004	Information Literacy	-	2
GIG1005	Social Engagement	-	2
GIA-GIXxxxx	External Faculty Elective Course	-	2
2. CORE COURSES (70 CREDITS)			
(I) FACULTY CORE COURSES (8 CREDITS) [TF]			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
SIX1001	Introduction to Science and Technology Studies	-	3
SIX1002	Ethics and Safety	-	2
SIX1004	Statistics	-	3
(II) PROGRAM CORE COURSES (62 CREDITS) [TP]			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
LEVEL 1 (24 Credits)			
SIM1001	Basic Mathematics	-	4
SIM1002	Calculus I	-	4
SIM1003	Calculus II	SIM1002	4
SIN1001	Introduction to Computing	-	2
SIN1002	Introduction to Worksheet	-	2
SIN1003	Mathematical Methods I	SIM1002	4
SIT1001	Probability and Statistics I	SIM1002	4
LEVEL 2 (34 Credits)			
SIM2001	Advanced Calculus	SIM1003	4
SIM2002	Linear Algebra	SIM1001	4
SIM2003	Introduction to Combinatorics	SIM1001	4
SIM2004	Algebra I	SIM1001	4
SIM2005	Introduction to Analysis	SIM1003	4
SIM2006	Complex Variables	SIM1003	4
SIM2007	Appreciation of Mathematics	SIM1003	2
SIN2001	Mathematical Methods II	SIN1003	4
SIN2002	Structured Programming	SIM1002	4
LEVEL 3 (4 Credits)			
SIN3015	Mathematical Science Project	SIM2002	4
3. ELECTIVE COURSES (35 CREDITS)			
(I) PROGRAM ELECTIVE COURSES (at least 28 CREDITS) [EP]			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
SIM2008	Theory of Differential Equations	SIN1003 and SIM2002	4
SIM2009	Geometry	SIM1001	4
SIM3001	Graph Theory	SIM2003	4
SIM3002	Combinatorial Mathematics	SIM2003	4
SIM3003	Number Theory	SIM2002	4
SIM3004	Advanced Linear Algebra	SIM2002	4
SIM3005	Matrix Theory	SIM2002	4
SIM3006	Algebra II	SIM2004	4
SIM3007	Ring Theory	SIM2004	4
SIM3008	Group Theory	SIM2004	4
SIM3009	Differential Geometry	SIM2001	4
SIM3010	Topology	SIM2001	4
SIM3011	Complex Analysis	SIM2006	4
SIM3012	Real Analysis	SIM2005	4
SIM3013	Probabilistic Methods in Combinatorics	SIM2003 and SIT1001	4
SIN3014	Industrial Training	SIM2002	5

(II) FACULTY ELECTIVE COURSES (7 CREDITS) [EF]

* Courses Offered by Other Institute/Department within the Faculty of Science
* Refer to the Faculty Elective Courses lists other than from the Institute of Mathematical Sciences but within the Faculty of Science

Institute/Department	Course Code	Course Title	Credits
Institute of Biological Sciences	SIX1006	Malaysian Flora	3
	SIX1007	Malaysian Fauna	3
	SIX1008	Bio Computing	2
Department of Chemistry	SIX1009	Basic Chemistry	2
Department of Geology	SIX1010	Earth's Ecosystem	2
Department of Physics	SIX1011	Contemporary Physics	2
Department of Science and Technology Studies	SIX1012	Logical Thinking in Science	3

The exact number of elective courses offered in each year may differ. Core courses in Bachelor of Science in Applied Mathematics or Bachelor of Science in Statistics may also be taken as elective courses of department for this program. Only SIQ2003 in Bachelor of Actuarial Science may be taken as an elective course of department for this program. Please refer to the respective programs.

Attention:

1. Students who wish to specialize in Bachelor of Science in Mathematics must take at least 24 credits from courses with codes SIM3***/SIN3***/SIT3***/SIQ3***(except SIN3014) of which at least 12 credits must be from SIM3***.
2. Students who wish to take SIN3014 or SIN3015 must pass at least 80 credits of the listed mathematics courses.

PROGRAM GOAL

To produce graduates with a sound knowledge of mathematics, capable of analysing and solving problems and thinking critically, able to adapt to diverse environments and contribute significantly in various professions.

PROGRAM EDUCATIONAL OBJECTIVES

1. Give opportunity to students to acquire the fundamental knowledge of mathematics. (PO1,2,6)
2. Prepare students with necessary mathematical and practical skills to assist them in their employment and research work. (PO1,2,6,7,8)
3. Guide and train students to communicate effectively and to be able to work independently as well as in teams. (PO3,4,5)

PROGRAM LEARNING OUTCOMES

At the end of the program, graduates with Bachelor of Science in Mathematics are able to:

1. Explain mathematical theory (pure, applied and statistics) which includes mathematical arguments, proofs and abstract concepts.
2. Perform mathematical computation, apply mathematical software and formulate real problems as mathematical models.
3. Conduct professional activities with good social skills, and demonstrate sense of responsibility in society.
4. Practice characteristics associated with professionalism and ethical responsibility in the field of mathematics.
5. Communicate relevant concepts effectively and accurately.
6. Analyse and assess problems, and develop strategies to obtain solutions.
7. Engage in life-long learning to advance knowledge and applications of mathematics.
8. Apply managerial and entrepreneurial skills to manage resources needed to complete a task.

LIST OF COURSES ACCORDING TO SEMESTER
(PLANNING OF COURSES)
BACHELOR OF SCIENCE IN MATHEMATICS

COMPONENT		YEAR 1				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
University Courses		GLT Communication in English	3	GLT Communication in English	3	**14**
		GIG1001 / GLT1017* TITAS / Basic Malay Language*	2	GIG1002 / GIG1006* Ethnic Relations/ Introduction to Malaysia*	2	
				GIG1004 Information Literacy	2	
				GIG1005 Social Engagement	2	
Core Courses	Faculty	SIX1004 Statistics	3	SIX1001 Introduction to Science and Technology Studies	3	**8**
				SIX1002 Ethics and Safety	2	
	Program	SIM1001 Basic Mathematics	4	SIM1003 Calculus II	4	**16**
		SIM1002 Calculus I	4	SIN1002 Introduction to Worksheet	2	
		SIN1001 Introduction to Computing	2			
TOTAL CREDIT			**18**		**20**	**38**

*only for international students

COMPONENT		YEAR 2				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
University Courses		GIG1003 Basic Entrepreneurship Culture	2	GKN/GRK/GKV Co-Curriculum	2	**6**
				GIX External Faculty Electives Course	2	
Core Courses	Program	SIT1001 Probability and Statistics I	4	SIM2005 Introduction to Analysis	4	**30**
		SIN1003 Mathematical Methods 1	4	SIM2006 Complex Variables	4	
		SIM2001 Advanced Calculus	4	SIM2007 Appreciation of Mathematics	2	
		SIM2002 Linear Algebra	4	SIN2001 Mathematical Methods II	4	
TOTAL CREDIT			**18**		**18**	**36**

COMPONENT		YEAR 3				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
Core Courses	Program	SIM2003 Introduction to Combinatorics	4			**12**
		SIM2004 Algebra I	4			
		SIN2002 Structured Programming	4			
Elective Courses	Faculty	Courses outside of Institute	3	Courses outside of Institute	2	**5**
	Program	SIM 2*** / 3***	4	SIM 3***	4	**20**
				SIM 3***	4	
				SIM 3***	4	
				SIM 3***	4	
TOTAL CREDIT			**19**		**18**	**37**

COMPONENT		YEAR 4				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
Core Courses	Program	SIN3015 Mathematical Science Project	4			**4**
Elective Courses	Faculty	Courses outside of Institute	2			**2**
	Program	SIM 3***	4			**8**
		SIM 3***	4			
TOTAL CREDIT			**14**			**14**

BACHELOR OF SCIENCE IN APPLIED MATHEMATICS SESSION 2019/2020 (128 CREDITS)			
1. UNIVERSITY COURSES (20 CREDITS)			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
GLTxxxx	Communication in English	-	6
GKN/GKR/GKV	Co-curriculum	-	2
GIG1001/ GLT1017	The Islamic and Asian Civilization (TITAS)/ Basic Malay Language (only for international students)	-	2
GIG1002/ GIG1006	Ethnic Relations/ Introduction to Malaysia (only for international students)	-	2
GIG1003	Basic Entrepreneurship Culture	-	2
GIG1004	Information Literacy	-	2
GIG1005	Social Engagement	-	2
GIXxxxx	External Faculty Elective Course	-	2
2. CORE COURSES (73 CREDITS)			
(I) FACULTY CORE COURSES (8 CREDITS) [TF]			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
SIX1001	Introduction to Science and Technology Studies	-	3
SIX1002	Ethics and Safety	-	2
SIX1004	Statistics	-	3
(II) PROGRAM CORE COURSES (65 CREDITS) [TP]			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
LEVEL 1 (24 Credits)			
SIM1001	Basic Mathematics	-	4
SIM1002	Calculus I	-	4
SIM1003	Calculus II	SIM1002	4
SIN1001	Introduction to Computing	-	2
SIN1002	Introduction to Worksheet	-	2
SIN1003	Mathematical Methods I	SIM1002	4
SIT1001	Probability and Statistics I	SIM1002	4
LEVEL 2 (36 Credits)			
SIM2001	Advanced Calculus	SIM1003	4
SIM2002	Linear Algebra	SIM1001	4
SIN2001	Mathematical Methods II	SIN1003	4
SIN2002	Structured Programming	SIM1002	4
SIN2003	Basic Operational Research	SIM1001 and SIN1002	4
SIN2004	Partial Differential Equations	SIN1003	4
SIN2005	System of Ordinary Differential Equations	SIN1003	4
SIN2006	Vector Analysis	SIM1003	4
SIT2001	Probability and Statistics II	SIT1001	4
LEVEL 3 (5 Credits)			
SIN3014	Industrial Training	SIM2002	5
3. ELECTIVE COURSES (35 CREDITS)			
(I) PROGRAM ELECTIVE COURSES (at least 28 CREDITS) [EP]			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
SIN2007	Management Mathematic	SIM1002	4
SIN2008	Optimization Technique	SIM2001	4
SIN2009	Computer Graphics	SIN1001 and SIN2002	4
SIN3001	Introduction to Quantum Mechanics with Computers	SIN2002	4
SIN3002	Cryptography	SIN2002 and SIT1001	4
SIN3003	Computational Fluid Dynamics	SIN2004	4
SIN3004	Analysis of Mathematical Models	SIN2005	4
SIN3005	Numerical Methods and Analysis	SIN2001	4
SIN3006	Production and Inventory Control	SIN2003 or SIN2007	4
SIN3007	Heuristic Methods	SIN2002	4
SIN3008	Mathematical Programming	SIN2003	4
SIN3009	Industrial Operational Research	SIN2003	4
SIN3010	Computational Geometry	SIN2002	4
SIN3011	Scientific Computing	SIN2002	4

SIN3012	Mechanics	SIN2006	4
SIN3013	Fourier and Wavelets Analysis	SIN1001 and SIM2002	4
SIN3015	Mathematical Science Project	SIM2002	4

(II) FACULTY ELECTIVE COURSES (7 CREDITS) [EF]

* Courses Offered by Other Institute/Department within the Faculty of Science

* Refer to the Faculty Elective Courses lists other than from the Institute of Mathematical Sciences but within the Faculty of Science

Institute/Department	Course Code	Course Title	Credits
Institute of Biological Sciences	SIX1006	Malaysian Flora	3
	SIX1007	Malaysian Fauna	3
	SIX1008	Bio Computing	2
Department of Chemistry	SIX1009	Basic Chemistry	2
Department of Geology	SIX1010	Earth's Ecosystem	2
Department of Physics	SIX1011	Contemporary Physics	2
Department of Science and Technology Studies	SIX1012	Logical Thinking in Science	3

The exact number of elective courses offered in each year may differ. Core courses in Bachelor of Science in Mathematics or Bachelor of Science in Statistics may also be taken as elective courses of department for this program. Only SIQ2003 in Bachelor of Actuarial Science may be taken as an elective course of department for this program. Please refer to the respective programs.

Attention:

1. Students who wish to specialize in Bachelor of Science in Applied Mathematics must take at least 20 credits from courses with codes SIN3***/SIM3***/SIT3***/SIQ3***(except SIN3014) of which at least 12 credits must be from SIN3***.
2. Students who wish to take SIN3014 or SIN3015 must pass at least 80 credits of the listed mathematics courses.

PROGRAM GOAL

To produce graduates with a sound knowledge in applied mathematics, capable of analysing and solving problems and thinking critically, able to adapt to diverse environment and contribute significantly in various professions.

PROGRAM LEARNING OUTCOMES

At the end of the program, graduates with Bachelor of Science in Applied Mathematics are able to:

1. Explain the principles and concepts of mathematics and it applications;
2. Apply the mathematical principles in solving real world problems;
3. Conduct professional activities with good social skill and demonstrate a sense of responsibility;
4. Practice characteristics associated with professionalism and ethical responsibility in the filled of mathematical applications;
5. Communicate using critical thinking with effective, accurate and relevant concepts;
6. Convert problems into mathematical models, and develop scientific strategies to obtain solutions;
7. Engage in life-long learning to advance knowledge and applications of mathematics;
8. Apply managerial and entrepreneurial skills to manage resources needed to complete a task.

LIST OF COURSES ACCORDING TO SEMESTER
(PLANNING OF COURSES)
BACHELOR OF SCIENCE IN APPLIED MATHEMATICS

COMPONENT		YEAR 1				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
University Courses		GLT Communication in English	3	GLT Communication in English	3	**14**
		GIG1001 / GLT1017* TITAS / Basic Malay Language*	2	GIG1002 / GIG1006* Ethnic Relations/ Introduction to Malaysia*	2	
				GIG1004 Information Literacy	2	
				GIG1005 Social Engagement	2	
Core Courses	Faculty	SIX1004 Statistics	3	SIX1001 Introduction to Science and Technology Studies	3	**8**
				SIX1002 Ethics and Safety	2	
	Program	SIM1001 Basic Mathematics	4	SIM1003 Calculus II	4	**16**
		SIM1002 Calculus I	4	SIN1002 Introduction to Worksheet	2	
		SIN1001 Introduction to Computing	2			
TOTAL CREDIT			**18**		**20**	**38**

*only for international students

COMPONENT		YEAR 2				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
University Courses		GIG1003 Basic Entrepreneurship Culture	2	GKN/GRK/GKV Co-Curriculum	2	**6**
				GIX External Faculty Electives Course	2	
Core Courses	Program	SIT1001 Probability and Statistics I	4	SIN2001 Mathematical Methods II	4	**28**
		SIN1003 Mathematical Methods I	4	SIN2002 Structured Programming	4	
		SIN2003 Basic Operational Research	4	SIN2006 Vector Analysis	4	
		SIM2001 Advanced Calculus	4			
Elective Courses	Faculty			Courses outside of ISM	2	**2**
TOTAL CREDIT			**18**		**18**	**36**

COMPONENT		YEAR 3						TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		SEMESTER 3		
		COURSE	CREDIT	COURSE	CREDIT	COURSE	CREDIT	
Core Courses	Program	SIN2004 Partial Differential Equations	4	SIT2001 Probability and Statistics II	4	SIN3014 Industrial Training	5	**21**
		SIN2005 System of Differential Equations	4	SIM2002 Linear Algebra	4			
Elective Courses	Faculty	Courses outside of ISM	3	Courses outside of ISM	2			**5**
	Program	SIN2***/SIN3***	4	SIN2***/SIN3***	4			**16**
		SIN2***/SIN3***	4	SIN2***/SIN3***	4			
TOTAL CREDIT			**19**		**18**		**5**	**42**

COMPONENT		YEAR 4				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
Elective Courses	Program	SIN2***/SIN3***	4			**12**
		SIN2***/SIN3***	4			
		SIN2***/SIN3***	4			
TOTAL CREDIT			**12**			**12**

BACHELOR OF SCIENCE IN STATISTICS
SESSION 2019/2020
(127 CREDITS)

1. UNIVERSITY COURSES (20 CREDITS)

COURSE CODE	COURSE NAME	PRE-REQUISITE	CREDITS
GLTxxxx	Communication in English	-	6
GKN/GKR/GKV	Co-curriculum	-	2
GIG1001/ GLT1017	The Islamic and Asian Civilization (TITAS)/ Basic Malay Language (only for international students)	-	2
GIG1002/ GIG1006	Ethnic Relations/ Introduction to Malaysia (only for international students)	-	2
GIG1003	Basic Entrepreneurship Culture	-	2
GIG1004	Information Literacy	-	2
GIG1005	Social Engagement	-	2
GIXxxxx	External Faculty Elective Course	-	2

2. CORE COURSES (72 CREDITS)

(I) FACULTY CORE COURSES (8 CREDITS) [TF]

COURSE CODE	COURSE NAME	PRE-REQUISITE	CREDITS
SIX1001	Introduction to Science and Technology Studies	-	3
SIX1002	Ethics and Safety	-	2
SIX1004	Statistics	-	3

(II) PROGRAM CORE COURSES (64 CREDITS) [TP]

COURSE CODE	COURSE NAME	PRE-REQUISITE	CREDITS
LEVEL 1 (24 Credits)			
SIM1001	Basic Mathematics	-	4
SIM1002	Calculus I	-	4
SIM1003	Calculus II	SIM1002	4
SIN1001	Introduction to Computing	-	2
SIN1002	Introduction to Worksheet	-	2
SIN1003	Mathematical Methods I	SIM1002	4
SIT1001	Probability and Statistics I	SIM1002	4
LEVEL 2 (36 Credits)			
SIM2001	Advanced Calculus	SIM1003	4
SIM2002	Linear Algebra	SIM1001	4
SIN2001	Mathematical Methods II	SIN1003	4
SIN2002	Structured Programming	SIM1002	4
SIT2001	Probability and Statistics II	SIT1001	4
SIT2002	Further Mathematical Statistics	SIT2001	4
SIT2003	Stochastic Processes	SIT2001	4
SIT2004	Regression Analysis	SIT1001	4
SIT2005	Data Analysis I	SIT1001	4
LEVEL 3 (4 Credits)			
SIT3001	Introduction to Probability Theory	SIM2001 and SIT2002	4

3. ELECTIVE COURSES (35 CREDITS)

(I) PROGRAM ELECTIVE COURSES (at least 28 CREDITS) [EP]

COURSE CODE	COURSE NAME	PRE-REQUISITE	CREDITS
SIT2006	Non-parametric Statistics	SIT1001	4
SIN3014	Industrial Training	SIM2002	5
SIN3015	Mathematical Science Project	SIM2002	4
SIT3002	Introduction to Multivariate Analysis	SIT2001	4
SIT3003	Computer Intensive Methods in Statistics	SIT2001	4
SIT3004	Applied Stochastic Processes	SIT2003	4
SIT3005	Time Series and Forecasting Methods	SIT2001	4
SIT3006	Further Topics in Regression Analysis	SIT2001 and SIT2004	4
SIT3007	Data Analysis II	SIT2001 and SIT2005	4
SIT3008	Introduction to Survey Sampling	SIT2001	4
SIT3009	Statistical Process Control	SIT2001	4
SIT3010	Introduction to Data Mining	SIT2001	4
SIT3011	Bioinformatics	SIT2001	4
SIT3012	Design and Analysis of Experiments	SIT1001 and SIT2004	4
SIT3013	Analysis of Failure and Survival Data	SIT2001	4

SIT3014	Introduction to Bayesian Statistics	SIT2001	4

(II) FACULTY ELECTIVE COURSES (7 CREDITS) [EF]

* Courses Offered by Other Institute/Department within the Faculty of Science
* Refer to the Faculty Elective Courses lists other than from the Institute of Mathematical Sciences but within the Faculty of Science

Institute/Department	Course Code	Course Title	Credits
Institute of Biological Sciences	SIX1006	Malaysian Flora	3
	SIX1007	Malaysian Fauna	3
	SIX1008	Bio Computing	2
Department of Chemistry	SIX1009	Basic Chemistry	2
Department of Geology	SIX1010	Earth's Ecosystem	2
Department of Physics	SIX1011	Contemporary Physics	2
Department of Science and Technology Studies	SIX1012	Logical Thinking in Science	3

The exact number of elective courses of department offered in each year may be different, depending on the availability of manpower. Core courses in Bachelor of Science in Mathematics or Bachelor of Science in Applied Mathematics may also be taken as elective courses of department for this program. Only SIQ2003 in Bachelor of Actuarial Science may be taken as an elective course of department for this program. Please refer to the respective programs.

Attention:

1. Students who wish to specialize in Bachelor of Science in Statistics must take at least 20 credits from courses with codes SIT3*** (not including SIN3014) listed in this program.
2. Students who wish to take SIN3014 or SIN3015 must pass at least 80 course credits listed in this program.

PROGRAM GOAL

To produce graduates with a sound knowledge of mathematics and statistics, thinking critically, solving problems, capable to adapt to diverse environment and capable of life-long learning.

PROGRAM LEARNING OUTCOMES

At the end of the program, graduates with Bachelor of Science in Statistics are able to:

1. Explain the principles and concepts of mathematics and statistics;
2. Apply the mathematical and statistical principles in solving real world problems;
3. Conduct professional activities with good social skill and demonstrate a sense of responsibility;
4. Practice characteristics associated with professionalism and ethical responsibility in analyzing real life phenomena;
5. Communicate using critical thinking with effective, accurate and relevant concepts, and exhibit team work and leadership skills;
6. Convert problems into mathematical and statistical models, and develop scientific strategies to obtain solutions;
7. Engage in life-long learning to advance knowledge and applications of mathematics and statistics;
8. Apply managerial and entrepreneurial skills to manage resources needed to complete a task.

LIST OF COURSES ACCORDING TO SEMESTER
(PLANNING OF COURSES)
BACHELOR OF SCIENCE IN STATISTICS

COMPONENT		YEAR 1				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
University Courses		GLT Communication in English	3	GLT Communication in English	3	**14**
		GIG1001 / GLT1017* TITAS / Basic Malay Language*	2	GIG1002 / GIG1006* Ethnic Relations/ Introduction to Malaysia*	2	
				GIG1004 Information Literacy	2	
				GIG1005 Social Engagement	2	
Core Courses	Faculty	SIX1001 Introduction to Science and Technology Studies	3	SIX1004 Statistics	3	**8**
		SIX1002 Ethics and Safety	2			
	Program	SIM1001 Basic Mathematics	4	SIM1003 Calculus II	4	**16**
		SIM1002 Calculus I	4	SIT1001 Probability and Statistics I	4	
TOTAL CREDIT			**18**		**20**	**38**

*only for international students

COMPONENT		YEAR 2				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
University Courses		GIG1003 Basic Entrepreneurship Culture	2	GKN/GRK/GKV Co-Curriculum	2	**6**
		GIXxxxx External Faculty Electives Course	2			
Core Courses	Program	SIN1001 Introduction to Computing	2	SIN1002 Introduction to Worksheet	2	**32**
		SIN1003 Mathematical Methods I	4	SIN2001 Mathematical Methods II	4	
		SIM2001 Advanced Calculus	4	SIN2002 Structured Programming	4	
		SIT2001 Probability and Statistics II	4	SIT2002 Further Mathematical Statistics	4	
				SIT2005 Data Analysis I	4	
TOTAL CREDIT			**18**		**20**	**38**

COMPONENT		YEAR 3				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
Core Courses	Program	SIM2002 Linear Algebra	4			**16**
		SIT2003 Stochastic Processes	4			
		SIT2004 Regression Analysis	4			
		SIT3001 Introduction to Probability Theory	4			
Elective Courses	Faculty			Courses outside of Institute	4	**4**
	Program	SIT2***/SIT3***	4	SIT3***	4	**16**
				SIT3***	4	
				SIT3***	4	
TOTAL CREDIT			**20**		**16**	**36**

COMPONENT		YEAR 4				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
Elective Courses	Faculty	Courses outside of Institute	3			**3**
	Program	SIT3***	4			**12**
		SIT3***	4			
		SIT3***	4			
TOTAL CREDIT			**15**			**15**

BACHELOR OF ACTUARIAL SCIENCE SESSION 2019/2020 (145 CREDITS)			
1. UNIVERSITY COURSES (22 CREDITS)			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
GLTxxxx	Communication in English	-	6
GKN/GKR/GKV	Co-curriculum	-	2
GIG1001/ GLT1017	The Islamic and Asian Civilization (TITAS)/ Basic Malay Language (only for international students)	-	2
GIG1002/ GIG1006	Ethnic Relations/ Introduction to Malaysia (only for international students)	-	2
GIG1003	Basic Entrepreneurship Culture	-	2
GIG1004	Information Literacy	-	2
GIG1005	Social Engagement	-	2
GIXxxxx	External Faculty Elective Course	-	4
2. CORE COURSES (83 CREDITS)			
(I) FACULTY CORE COURSES (8 CREDITS) [TF]			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
SIX1001	Introduction to Science & Technology Studies	-	3
SIX1002	Ethics and Safety	-	2
SIX1004	Statistics	-	3
(II) PROGRAM CORE COURSES (75 CREDITS) [TP]			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
LEVEL 1 (17 Credits)			
SIM1001	Basic Mathematics	-	4
SIM1002	Calculus I	-	4
SIN1002	Introduction to Worksheet	-	2
SIM1003	Calculus II	SIM1002	4
SIQ1001	Introduction to Accounting	-	3
LEVEL 2 (26 Credits)			
SIM2001	Advanced Calculus	SIM1003	4
SIN2002	Structured Programming	SIM1002	4
SIT1001	Probability and Statistics I	SIM1002	4
SIT2001	Probability and Statistics II	SIT1001	4
SIQ2001	Microeconomics	-	3
SIQ2002	Macroeconomics	-	3
SIQ2003	Financial Mathematics and Derivatives	SIM1002	4
LEVEL 3 (16 Credits)			
SIQ3001	Actuarial Mathematics I	SIQ2003	4
SIQ3002	Portfolio Theory and Asset Models	SIQ2003	4
SIQ3003	Actuarial Mathematics II	SIQ3001	4
SIQ3004	Mathematics of Financial Derivatives	SIQ2003	4
LEVEL 4 (16 Credits)			
SIQ3005	Life Insurance and Takaful	SIT2001	4
SIQ3006	Risk Theory	SIT2001 and SIQ2003	4
SIQ3007	Industrial Training	-	8
3. ELECTIVE COURSES (40 CREDITS)			
(I) PROGRAM ELECTIVE COURSES (at least 31 CREDITS) [EP]			
COURSE CODE	**COURSE NAME**	**PRE-REQUISITE**	**CREDITS**
SIN1003	Mathematical Methods I	SIM1002	4
SIM2002	Linear Algebra	SIM1001	4
SIN2001	Mathematical Methods II	SIN1003	4
SIN2003	Basic Operational Research	SIM1001	4
SIT2002	Further Mathematical Statistics	SIT2001	4
SIT2003	Stochastic Processes	SIT2001	4
SIT2004	Regression Analysis	SIT1001	4
SIN3015	Mathematical Science Project	SIM2002	4
SIT3003	Computer Intensive Methods in Statistics	SIT2001	4
SIT3004	Applied Stochastic Processes	SIT2003	4
SIT3005	Time Series and Forecasting Methods	SIT2001	4
SIT3006	Further Topics in Regression Analysis	SIT2001 and SIT2004	4

SIT3010	Introduction to Data Mining	SIT2001	4
SIQ3008	Foundation of Islamic Finance	SIN2002	4
SIQ3009	Pension Mathematics	SIQ3001	4
SIQ3010	Survival Model	SIT2001	4

(II) FACULTY ELECTIVE COURSES (9 CREDITS) [EF]

* Courses Offered by Other Institute/Department within the Faculty of Science
* Refer to the Faculty Elective Courses lists other than from the Institute of Mathematical Sciences but within the Faculty of Science

Institute/Department	Course Code	Course Title	Credits
Institute of Biological Sciences	SIX1006	Malaysian Flora	3
	SIX1007	Malaysian Fauna	3
	SIX1008	Bio Computing	2
Department of Chemistry	SIX1009	Basic Chemistry	2
Department of Geology	SIX1010	Earth's Ecosystem	2
Department of Physics	SIX1011	Contemporary Physics	2
Department of Science and Technology Studies	SIX1012	Logical Thinking in Science	3

1. The exact number of courses (as shown above) that will be offered for any year may be different, depending on the availability of manpower.
2. Core courses under Bachelor of Science in Mathematics, Bachelor of Science in Applied Mathematics or Bachelor of Science in Statistics may also be taken by a student in Bachelor of Actuarial Science program as Program Elective Courses. Please refer to the relevant programs.
3. Actuarial students must take at least 110 of credits before undergoing the practical training (SIQ3007).
4. Actuarial students are also encouraged to take CIX2001 (Financial Management) and CIC2001 (Basic Corporate Finance) as Program Elective Courses.

Attention:
Courses with codes SIQ**** except SIQ2003 are exclusive for students in Bachelor of Actuarial Science.

PROGRAM GOAL

To produce graduates with sound knowledge in the actuarial field through exploration in the theoretical and application of mathematics, statistics, economics and finance, able to think critically in problem solving as well as capable to increase competitiveness in the national and international level.

PROGRAM EDUCATIONAL OBJECTIVES

1. To prepare the students with theoretical and practical aspects as well as special skills in the actuarial field. (PO1, 2, 6)
2. To build actuarial ethics and professionalism required by the students in research and employment through effective communication. (PO3, 4, 5)
3. To train the students to work independently as well as in a team to organise knowledge and practical skills as enhancement of competitiveness. (PO1, 2, 7, 8)

PROGRAM LEARNING OUTCOMES

At the end of the program, graduates with Bachelor of Actuarial Science are able to:

1. Explain the principles and concepts of actuarial science, finance, statistics and mathematics;
2. Apply actuarial science, finance, statistics and mathematics concepts to solve real-world problems;
3. Conduct professional activities with good social skills and demonstrate a sense of responsibility;
4. Practice characteristics associated with professionalism and ethical responsibility in analyzing real life phenomena;
5. Communicate using critical thinking with effective, accurate and relevant concepts, and exhibit team work and leadership skills;
6. Convert problems into actuarial, financial, statistical and mathematical models, and develop scientific strategies to obtain solutions;
7. Engage in life-long learning to advance knowledge and applications of actuarial science, finance, statistics and mathematics;
8. Apply managerial and entrepreneurial skills to manage resources needed to complete a task.

LIST OF COURSES ACCORDING TO SEMESTER
(PLANNING OF COURSES)
BACHELOR OF ACTUARIAL SCIENCE

COMPONENT		YEAR 1				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
University Courses		GLT Communication in English	3	GLT Communication in English	3	**14**
		GIG1001 / GLT1017* TITAS / Basic Malay Language*	2	GIG1002 / GIG1006* Ethnic Relations/ Introduction to Malaysia*	2	
				GIG1004 Information Literacy	2	
				GIG1005 Social Engagement	2	
Core Courses	Faculty	SIX1001 Introduction to Science and Technology Studies	3	SIX1004 Statistics	3	**8**
		SIX1002 Ethics and Safety	2			
	Program	SIM1001 Basic Mathematics	4	SIM1003 Calculus II	4	**15**
		SIM1002 Calculus I	4	SIQ1001 Introduction to Accounting	3	
TOTAL CREDIT			**18**		**19**	**37**

*only for international students

COMPONENT		YEAR 2				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
University Courses		GIG1003 Basic Entrepreneurship Culture	2	GKN/GRK/GKV Co-Curriculum	2	**8**
		GIX External Faculty Electives Course	2			
		GIX External Faculty Electives Course	2			
Core Courses	Program	SIM2001 Advanced Calculus	4	SIN2002 Structured Programming	4	**28**
		SIQ2001 Microeconomics	3	SIQ2002 Macroeconomics	3	
		SIQ2003 Financial Mathematics and Derivatives	4	SIT2001 Probability and Statistics II	4	
		SIT1001 Probability and Statistics I	4	SIN1002 Introduction to Worksheet	2	
Elective Courses	Faculty			FACULTY ELECTIVE COURSES	3	**3**
	Program			CIX2001 Financial Management	3	**3**
TOTAL CREDIT			**21**		**21**	**42**

COMPONENT		YEAR 3				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
Core Courses	Program	SIQ3001 Actuarial Mathematics I	4	SIQ3003 Actuarial Mathematics II	4	**16**
		SIQ3002 Portfolio Theory and Asset Models	4	SIQ3004 Mathematics of Financial Derivatives	4	
Elective Courses	Faculty	FACULTY ELECTIVE COURSES	3	FACULTY ELECTIVE COURSES	3	**6**
	Program	SIM/SIN/SIT 2/3***	4	SIM/SIN/SIQ/SIT 2/3***	4	**16**
		CIC2001 Basic Corporate Finance	4	SIM/SIN/SIQ/SIT 2/3***	4	
TOTAL CREDIT			**19**		**19**	**38**

COMPONENT		YEAR 4				TOTAL CREDIT
		SEMESTER 1		SEMESTER 2		
		COURSE	CREDIT	COURSE	CREDIT	
Core Courses	Program	SIQ3005 Life Insurance and Takaful	4	SIQ3007 Industrial Training	8	**16**
		SIQ3006 Risk Theory	4			
Elective Courses	Program	SIM/SIN/SIQ/SIT 2/3***	4			**12**
		SIM/SIN/SIQ/SIT 2/3***	4			
		SIM/SIN/SIQ/SIT 2/3***	4			
TOTAL CREDIT			**20**		**8**	**28**

INSTITUTE OF MATHEMATICAL SCIENCES

The Institute of Mathematical Sciences (ISM) was established as a department in the Faculty of Science when the University of Malaya was founded in Kuala Lumpur in 1959. It has grown into three branches, i.e., pure mathematics, applied mathematics, and statistics.

For the 2018/2019 session, ISM offers the following four first degree programs:

- Bachelor of Science in Mathematics
- Bachelor of Science in Applied Mathematics
- Bachelor of Science in Statistics
- Bachelor of Actuarial Science

The four Bachelor of Science programs are set up to provide more opportunities for an undergraduate to major in the field of mathematics according to his or her interests. All these programs will assist to fulfill the vacancies of skilled workforce in science and technology in the public and private sectors in line with Malaysia's aspiration to become a developed nation.

STAFF

ISM has a group of experienced lecturers in teaching. They are also active in doing research and have been publishing many writings in local and international journals. The research activities encompass a broad spectrum, from findings and knowledge which are abstract in nature, to those with direct applications in the industry. ISM also strives to establish and forge a close relationship with industry and other research institutions. This strengthens the quality of teaching and supervising of projects/theses for students in bachelor's, Master's and doctoral levels.

HEAD:
Associate Prof. Dr. Wan Ainun Mior Othman, *BSc (UNCC), MSc (N Carolina State), PhD (USM)*

DEPUTY HEAD:
Associate Prof. Dr. Deng Chai Ling, *BSc, MSc, PhD*
Dr. Rossita Mohamad Yunus, *BSc, MSc(UM), PhD(USQ)*

PURE MATHEMATICS UNIT

COORDINATOR (B.Sc. in MATHEMATICS):
Associate Prof. Dr. Wong Kok Bin, *BSc, MSc, PhD*

PROFESSORS:
Dr. Angelina Chin Yan Mui, *BSc, MSc, PhD(Q'ld)*
Dr. Suzeini Abd Halim, *BSc(UNSW), PhD(Wales)*

ASSOCIATE PROFESSORS:
Dr. Chooi Wai Leong, *BSc, MSc, PhD*
Dr. Deng Chai Ling, *BSc, MSc, PhD*
Dr. Wong Kok Bin, *BSc, MSc, PhD*

LECTURERS:
Dr. Loo Tee How, *BSc, MSc, PhD*
Mr. Mohamad Bakri Zubir, *BSc, MSc(Exeter)*
Dr. Ong Siew Hui, *BSc, MSc, PhD*
Dr. Oon Shea Ming, *BSc, MSc, PhD(UHP)*
Dr. Tan Ta Sheng, *BA, CASM, MMath, MA, PhD(Cambridge)*

APPLIED MATHEMATICS UNIT

COORDINATOR:
Dr. Zailan Siri, *BSc, MSc(UPM), PhD(UKM)*

PROFESSORS:
Dr. Mohd Omar, *BSc, MSc(Hull), PhD(Exeter)*

ASSOCIATE PROFESSOR:
Dr. Wan Ainun Mior Othman, *BSc(UNCC), MSc(N Carolina State), PhD(USM)*
Dr. Zailan Siri, *BSc, MSc(UPM), PhD(UKM)*

LECTURERS:
Dr. Amizah Malip, *BSc. (UIA) Msc, PhD(UK)*
Dr. Kumaresan Nallasamy, *PhD(GRU, India)*
Dr. Kwa Kiam Heong, *Bsc, MSc, PhD(Ohio State)*
Dr. Noor Fadiya Mohd Noor, *BSc(UTM), MSc(UTM), PhD(UKM)*
Dr. Siti Suzlin Supadi,*BSc, MSc, PhD*

STATISTICS AND ACTUARIAL SCIENCE UNIT

COORDINATOR (B.Sc. in STATISTICS):
Dr. Ng Choung Min, *BSc(UTM), MSc, PhD*

COORDINATOR (B. ACTUARIAL SCIENCE):
Dr. Koh You Beng, *BSc(UMS), MSc(UM), PhD(HKU)*

PROFESSORS:
Dr. Ibrahim Mohamed, *BSc(Bristol), MSc(Reading), PhD(UiTM)*
Dr. **Nor Aishah Hamzah**, *BSc(Southampton), MSc(Leeds), PhD(Bristol), DipEd(UKM), MIS(UK)*

LECTURERS:
Dr. Adriana Irawati Nur Ibrahim, *BSc(USM), MSc(UM), PhD(Bath)*
Dr. Dharini Pathmanathan, *BSc, MSc, PhD(UM)*
Dr. Khang Tsung Fei, *BSc, MSc(UM), PhD(NUS)*
Dr. Lim Sok Li, *BEd(USM), MSc(USM), PhD(USM)*
Dr. Mohd Azmi Haron, *BSc, MBA(UPM), PhD(UPM)*
Dr. Ng Choung Min, *BSc(UTM), MSc, PhD*
Dr. Ng Kok Haur, *BSc(UPM), MSc(UPM), PhD*
Dr. Nur Anisah Mohamed, *BSc, MSc(UM), PhD(Newcastle)*
Dr. Rossita Mohamad Yunus, *BSc, MSc(UM), PhD(USQ)*
Dr. Shaiful Anuar Abu Bakar, *BSc(UiTM), MSc(Heriot-Watt), PhD(Manchester)*

COORDINATOR (B.Sc. Ed. Mathematics):
Mr. Mohamad Bakri Zubir, *BSc, MSc(Exeter)*

RESEARCH AREAS

Research areas at ISM include:

differential geometry, group theory, ring theory, functional identities, linear and multilinear algebra, matrix theory, combinatorial graph theory, graph theory, social network analysis, supply chain management, operations research, numerical analysis, computational statistics, robust statistics, probability distribution theory, nonlinear time series, image processing, regression analysis, and statistical quality control.

COMPUTER FACILITIES

Currently, ISM has a computer lab equipped with 10 laptops, 17 workstations, 121 desktops, 3 laser printers, 1 colour printer, and 4 heavy-duty dot matrix printers, all of which being interconnected in a network system. The lab is also equipped with 4 LCD projectors, 2 visualizers, and 3 scanners. The lab utilizes state-of-the-art software such as MATLAB (with various toolboxes), SPSS, Wolfram Mathematica, MathType, Minitab, Microsoft Visual C++, Dev-C++, and S-PLUS. In addition, three of the lecture halls and tutorial rooms are each equipped with a LCD projector and a visualizer.

BACHELOR OF SCIENCE PROGRAMS

Please refer to Program Structure for courses.

FURTHER DEGREE

Apart from teaching and supervising at the bachelor's level, the staff members of the institute also supervise research projects that lead to Master's and doctorate degrees in the three branches of mathematics.

JOB OPPORTUNITIES

The learning of mathematics will help increase one's skills in problem solving and analysis. It trains one's mind to manipulate information, to form accurate, complicated and abstract ideas and to enable one to discern complicated arguments. The training to think quantitatively, logically and analytically in problem solving may prove valuable in one's chosen career.

Since the use of mathematics is all encompassing in human endeavour, a graduate's career opportunities are almost limitless and not only confined to teaching and research. Many graduates from this Institute have been employed in the financial sectors (banking, accountancy and insurance for instance), management, business, industry and computing sectors.

SYNOPSIS OF COURSES

SIX1004 STATISTICS (FACULTY OF SCIENCE)

Introduction to statistical analysis; Experimental and observational studies; Display and organization of data; Descriptive statistics; Population and samples; Sampling methods; Basic probability theory; Useful probability distributions: Binomial, Poisson and normal; Sampling distributions; Central Limit Theorem; Parameter estimation and confidence intervals; Hypothesis testing for mean, proportion and association in one and two populations; Chi-squared tests and Fisher's exact test; One factor Analysis of Variance; Simple linear regression.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:
1. Freedman, D., Pisani, R., & Purves, R. (2007). *Statistics* (4th ed.). New York: W.W. Norton.
2. Mann, P. S. (2010). *Introductory statistics* (7th ed.). New York: Wiley.
3. Johnson, R., & Kuby, P. (2011). *Elementary statistics* (11th ed.). Boston: Cengage Learning.

SIM1001 BASIC MATHEMATICS

Introductory logic. Mathematical statements. Quantifiers. Rules of inference. Mathematical induction, binomial theorem. Sets, Cartesian products, equivalence relations, functions, bijections, inverse functions. Integers, rational numbers, real numbers. Complex numbers. DeMoivre's theorem and roots of unity. Polynomials and equations. Remainder theorem, fundamental theorem of algebra, conjugate roots.

Systems of linear equations, row reduction, echelon forms. Matrix operations, algebraic properties of matrices, inverses, elementary matrices, linear independence and homogeneous linear systems, matrices with special forms. Determinants, cofactor expansion, properties of determinants, Cramer's rule, eigenvalues, eigenvectors and diagonalization.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:
1. Epp, Sussana S. (2011). *Discrete mathematics with applications* (4th ed.). Cengage Learning.
2. Ensly, Douglas E., & Crawley, J.W. (2006). *Discrete mathematics.* John Wiley and Sons.
3. Devlin, K. (1992). *Sets, functions and logic* (2nd ed.). Chapman & Hall.
4. Anton, H., & Rorres, C. (2005). *Elementary linear algebra with applications* (9th ed.). Wiley High Education Inc.
5. Larson, R., & Falvo D. (2012). *Elementary linear algebra* (7th ed.). Brooks/Cole Thomson Learning.

SIM1002 CALCULUS I

Real numbers and real line. Inequality and absolute values. Functions and their graphs. Combining functions. Limits: intuitive, limit laws, one-sided limits, limits involving infinity, epsilon-delta definition for limits. Continuity. Derivatives: tangent lines and definition for derivatives. Differentiation rules including the Chain Rule and implicit differentiation. Rolle's Theorem, The Mean Value Theorem, maximum, minimum, concavity and points of inflection. Graph sketching. Logarithms, exponential functions. Indeterminate forms and L'Hôpital's Rule. Definite and indefinite integrals. Fundamental theorem of Calculus and differentiation of integrals. Integration methods.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:
1. Weir, Maurice D., & Hass. J. (2016). *Thomas' calculus* (13th ed.) Pearson Educatio, Inc.

2. Stewart, J. (2015). *Calculus* (8th ed.). Cengage Learning.
3. Adams, Robert A., & Essex, C. (2013). *Calculus: A complete course* (8th ed. With MyMathLab). Pearson Education.

SIM1003 CALCULUS II

Inverses of trigonometric functions, hyperbolic functions, inverses of hyperbolic functions. Integration by parts, integration of rational functions by partial fractions, trigonometric integrals, trigonometric substitutions, improper Integrals. Sequence, infinite series, integral test, comparison tests, the ratio and root tests, alternating series test, absolute and conditionally convergence, power series, Taylor and Maclaurin series. Vectors, Dot product, Cross Product and triple Product, lines and planes. Polar coordinates. Cyclinder and quadric surfaces. Vector-valued functions and space curves, differentiation and integration of vector valued functions. Functions of several variables, limits and continuity in higher dimensions.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:
1. Weir, Maurice D., & Hass, J. (2016). *Thomas' calculus* (13th ed.) Pearson Education, Inc.
2. Stewart, J. (2015). *Calculus* (8th ed.). Cengage Learning.
3. Adams, Robert A., & Essex, C. (2013). *Calculus: A complete course* (8th ed. With MyMathLab). Pearson Education.
4. R.T. Smith, R.T., & Minton, R.B. (2012). *Calculus* (4th ed.). McGraw-Hill.

SIM2001 ADVANCED CALCULUS

Partial derivatives. Differentiability and continuity. Linearization and differentials. The Chain Rule, Partial derivatives with constrained variables. Directional derivatives. Gradient. Divergence and Curl. Tangent planes. Taylor's Theorem. Extremum problems of functions of two variables. Lagrange multipliers.

Double integrals, iterated integrals and Fubini's Theorem. Applications to areas and volumes. Double integrals in polar form. Triple integrals, iterated integrals. Volumes and masses. Triple integrals in cylindrical and spherical coordinates forms. Substitution in multiple integrals, Jacobians.

Basic set theory. Functions, bijective functions, inverse functions. Finite and infinite sets, countable and uncountable sets. The Real Number system. Bounds, supremum and infimum. Archimedean property. Rational and irrational numbers. Properties of real numbers. Sequences of real numbers, convergence. Limit Theorems. Monotone sequences, Cauchy sequences and subsequences. Basic topology of the real line: Open and closed sets, accumulation points.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References:
1. Weir, Maurice D., & Hass, J. (2016). *Thomas' calculus* (13th ed.). Pearson Education, Inc.
2. Stewart, J. (2015). *Calculus* (8th ed.). Cengage Learning.
3. Bartle, R.G., & Sherbert, D.R. (2011). *Introduction to real analysis* (4th ed.). John Wiley & Sons.
4. Lay, S.R. (2014). *Analysis with an introduction to proof (5th ed.).* Pearson.

SIM2002 LINEAR ALGEBRA

Vector spaces and subspaces, basis and dimension, the row space and column space, rank and nullity. Linear transformations, kernel and range, composition and isomorphism, matrix representation, similarity and diagonalizability, Cayley-Hamilton Theorem.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References:
1. Larson, R. (2017). *Elementary Linear algebra* (8th ed.). Mason, OH: Cengage Learning.
2. Sheldon, A. (2015). *Linear algebra done right* (3rd ed.). New York, NY: Springer International Publishing.
3. Hoffman, K. M., Kunze, R. (1971). *Linear algebra* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.
4. Friedberg, S.H., Insel, A.J., & Spence, L.E. (2002). *Linear algebra* (4th ed.). Upper Saddle River, NJ: Prentice – Hall.
5. Ma, S.L., Tan, V., & Ng, K.L. (2007). *Linear algebra I* (3rd ed.). Singapore: Pearson Prentice-Hall.

SIM2003 INTRODUCTION TO COMBINATORICS

Ordered and equivalence relations, binomial and multinomial theorems, recurrence relations, principle of inclusion and exclusion, Latin squares, magic squares, basic properties of graphs, circuits and cycles in graphs, trees and their applications.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References:
1. Erickson, M.J. (2013). *Introduction to combinatorics* (2nd ed.). Wiley.
2. Chen, C.C., & Koh, K.M. (1992). *Principles and techniques in combinatorics*. World Scientific.
3. Lovasz, L., Pelikan, J., & Vesztergombi, K. (2003). *Discrete mathematics: Elementary and beyond*. Springer.
4. Matousek J., & Nesetril J. (2008). *Invitation to discrete mathematics* (2nd ed.). Oxford University Press.

SIM2004 ALGEBRA I

Groups and subgroups. Order of an element and order of a subgroup. Lagrange's theorem. Normal subgroups and factor groups. Homomorphisms and isomorphisms, Rings, integral domains and fields. Subrings and subfields. Ideals and quotient rings. Rings of polynomials. The Division algorithm and Euclidean algorithm in polynomial rings. Unique factorization theorem.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:

1. Gilbert, L., Gilbert, J. (2014). *Elements of modern algebra* (8th ed.). Brooks/Cole.
2. Durbin, J.R. (2008). *Modern algebra: An introduction* (6th ed.). John Wiley.
3. Judson, T.W. (2018). *Abstract algebra: Theory and applications*. Open Source.

SIM2005 INTRODUCTION TO ANALYSIS

Sequences. Infinite series, convergence. Tests of convergence. Absolute and conditional convergence. Rearrangement of series. Topology of the real line. Compactness. Properties of continuous functions. Uniform continuity. Derivative of a function. Properties of differentiable functions. Mean Value Theorems. Higher order derivatives. de l'Hôpital's rule.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References:

1. Lay, R. (2014). *Analysis with an Introduction to proof* (5th ed.). Pearson.
2. Kosmala, W. (2004). *A friendly introduction to analysis* (2nd ed.). Pearson.
3. Haggarty, R. (1993). *Fundamentals of mathematical analysis* (2nd ed.). Addison-Wesley Publ. Co.
4. Bartle, R.G., & Sherbert, D.R. (2011). *Introduction to real analysis* (4th ed.). John Wiley & Sons Inc.
5. Oon, S.M (2017). *A first course in real analysis*. University of Malaya Press.

SIM2006 COMPLEX VARIABLES

Complex numbers system. Complex functions, limits, continuity, differentiability and analytic function. Cauchy-Riemann equations, Harmonic functions. Mappings and other properties of elementary functions. Complex Integrations, Cauchy's Theorem, Cauchy's Integral Formula.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:

1. Churchill, R.V., & Brown, J.W. (2013). *Complex variables and applications* (9th ed.). New York, NY: McGraw-Hill Education.
2. Mathews, J.H., & Howell, R.W. (2012). *Complex analysis for mathematics and engineering* (6th ed.). Bullington, MA: Jones & Bartlett Learning.
3. Nguyen, H.B. (1994). *Analisis kompleks dan penerapan*. Malaysia: Dewan Bahasa dan Pustaka.
4. Howie, J.M. (2007). *Complex analysis* (3rd ed.). New York, NY: Springer.

SIM2007 APPRECIATION OF MATHEMATICS

Students will be put into groups. Each group will be given 2 mathematical tasks to work on. These tasks will come from a variety of topics selected from, but not limited to: algebra, geometry, combinatorics, applied and computational mathematics, probability and statistics, science & technology, mathematics and society, management science, finance mathematics, actuarial sciences, history and philosophy. Students collectively will use tools/elements of mathematics to undertake each task. In undertaking these tasks, students are required to carry out to a certain extend some literature survey, background reading and explore some elementary research problems. During guided learning sessions, students are also expected to critique, analyse, argue logically and deduce findings. Each group is required to produce and present reports for the tasks given.

Assessment:
Coursework: 100%

Medium of Instruction:
English

Soft Skills:
CS4, TS3, LL2, EM2, LS2

SIM2008 THEORY OF DIFFERENTIAL EQUATIONS

The existence and uniqueness theorem. Solutions to the system of linear differential equations with constant coefficients. Automatic linear system and linear approximation of dimension two, types of critical points, stability.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS5, LL2

References:

1. Zill D.G., Wright, W.S., & Cullen, M.R. (2013). *Differential equations with boundary-value problems* (8th ed.). Brooks/Cole Cengage Learning.
2. Chicone, C. (2006). *Ordinary differential equations with applications* (2nd ed.). Springer.
3. Logan. J.D. (2011). *A first course in differential equations* (2nd ed.). Springer.

SIM2009 GEOMETRY

Euclidean Geometry, congruence, parallelism, similarity, isometry, Incidence geometry of the sphere, motions of the sphere.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References:

1. Ryan P.J. (1986). *Euclidean and non-Euclidean geometry*. Cambridge Univ. Press.
2. Kumaresan S. (2005). *An expedition to geometry.* Hindustan Book Agency
3. Henle, M. (2001). *Modern geometries: Non-Euclidean, projective, and discrete geometry* (2nd ed.). Pearson.
4. Kappraff, J. (2014). *A participatory approach to modern geometry*. World Scientific.

SIM3001 GRAPH THEORY

Graph theory and its applications.

Topics will be selected from the following: Eulerian graphs, trees, planar graphs, graph colouring and chromatic polynomials, Hamiltonian graphs, matching theory, directed graphs and the shortest path problem, network theory.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:

1. Koh, K.M., Dong, F., Ng, K.L., & Tay, E.G. (2015). *Graph theory: Undergraduate mathematics*. World Scientific.
2. Chartrand, G., & Lesniak, L. (2010). *Graphs and digraphs* (5th ed.). CRC Press.
3. Gross, J.L., Yellan, J., & Zhang, P. (2013). *Handbook of graph theory* (Discrete mathematics and its applications) (2nd ed.). CRC Press.

SIM3002 COMBINATORIAL MATHEMATICS

Theory of Enumeration: Topics will be chosen from: Permutation and Combination, advanced counting numbers, generating functions, principle of inclusion and exclusion.

Combinatorial Designs: Topics will be chosen from: Block designs, balanced incomplete block designs, Steiner triple system, Hadamard matrices, pigeonhole principle and Ramsey theory for graphs.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References:

1. Brualdi, R. A. (2009). *Introductory combinatorics* (5th ed.). Pearson Prentice Hall.
2. Stanley, R.P. (2011). *Enumerative combinatorics* (2nd ed.). (Vol. 1). Cambridge University Press.
3. Liu, C.L. (1968). *Introduction to combinatorial mathematics, Computer science series*. McGraw Hill Book Co.
4. Street, A.P., & Wallis, W.D. (1997). *Combinatorial theory: An introduction*. Manitoba, Canada: The Charles Babbage Research Center.
5. Tucker, A. (2012). *Applied combinatorics* (6th ed.). John Wiley and Sons.

SIM3003 NUMBER THEORY

Prime Numbers. The Division Algorithm and Unique Factorization Theorem for Integers. Linear Diophantine Equations. Theory of congruence and the Chinese Remainder Theorem. RSA encryption. Quadratic reciprocity and the Legendre symbol. Arithmetic functions. Primitive roots.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS5, LL2

References:

1. Burton, D. (2010). *Elementary number theory* (7th ed.). McGraw Hill Publ. Co.
2. Rosen, K. H. (2010) *Elementary number theory and its applications* (6th ed.). Pearson Addison Wesley.
3. Davenport, H. (2008). *The higher arithmetic* (8th ed.). Cambridge University Press.
4. Baker, A. (1985). *A concise introduction to the theory of numbers*. Cambridge University Press.
5. Baker, A. (2012). *A comprehensive course in number theory.* Cambridge University Press.

SIM3004 ADVANCED LINEAR ALGEBRA

Inner product spaces, the Gram-Schmidt orthogonalization process and orthogonal complements. Orthogonal operators, unitary operators, self-adjoint operators and positive definite operators. Dual spaces, bilinear forms. Diagonalization of symmetric bilinear forms, real quadratic forms. Triangularization theorem, primary decomposition theorem, Jordan canonical forms.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%
Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2
References:

1. Hoffman, K.M., & Kunze, R. (1971). *Linear algebra* (2nd ed.) Englewood Cliffs, NJ: Prentice-Hall.
2. Kwak, J.H., & Hong, S.P., (2004). *Linear algebra* (2nd ed.). New York, NY: Birkhäuser Basel.

3. Friedberg, S.H., Insel, A.J., & Spence, L.E. (2002). *Linear algebra* (4th ed.). Upper Saddle River, NJ: Prentice-Hall.
4. Sheldon, A. (2015). *Linear algebra done right* (3rd ed.). New York, NY: Springer International Publishing.
5. Yang, Y.S. (2015). *A concise text on advanced linear algebra.* Cambridge, NY: Cambridge University Press.

SIM3005 MATRIX THEORY

Rank and nullity of matrices. Inner product spaces, the Gram-Schmidt process, least squares problems, ortogonal matrices. Diagonalization for real symmetric matrices, quadratic forms, semi positive definite matrices. The singular value decomposition. Generalized inverses and linear systems, Moore-Penrose inverses.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References:
1. Zhang, F.Z. (2011). *Matrix theory: Basic results and techniques* (2nd ed.). New York, NY: Springer-Verlag.
2. Horn, R., & Johnson, C.R. (2013). *Matrix analysis* (2nd ed.). Cambridge, NY: Cambridge University Press.
3. Steeb, W., & Hardy, Y. (2011). *Matrix calculus and Kronecker product* (2nd ed.). Singapore: World Scientific Publishing.
4. Bapat, R.B. (2012). *Linear algebra and linear Models* (3rd ed.). London, UK: Springer-Verlag.
5. Zhan, X.Z. (2013). *Matrix theory*. Providence, RI: American Mathematical Society.

SIM3006 ALGEBRA II

Groups-Isomorphism theorems. Permutation groups. Group actions, *p*-groups.

Rings-Maximal and prime ideals. Polynomial rings. Field extensions. Finite fields.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:
1. Durbin, J. R. (2009). *Modern algebra: An Introduction* (6th ed.). John Wiley.
2. Fraleigh, J. B. (2003). *A first course in abstract algebra* (7th ed.). Addison-Wesley.
3. Gallian, J. (2012). *Contemporary abstract algebra* (8th ed.). Brooks/Cole Cengage Learning.
4. Hungerford, T.W. (2014). *Abstract algebra: An Introduction* (3rd ed.). Brooks/Cole Cengage Learning.

SIM3007 RING THEORY

Ring, subrings and ideals, modules, internal direct sum, external direct product, nil and nilpotent ideals, prime and maximal ideals, Jacobson and prime radicals, semiprimitive and semiprime rings, rings with chain condition, primitive rings, group rings.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:
1. Cohn, P.M. (2001). *Introduction to Ring Theory* (Springer Undergraduate Mathematics Series). Springer.
2. Herstein, I. N. (2005). *Noncommutative rings* (Carus Mathematical Monographs No. 15). Math. Assoc. of America.
3. Beachy, J. A. (1999). *Introductory lectures on rings and modules* (London Maths. Soc. Student Texts 47). Cambridge University Press.
4. Lam, T.Y. (2010). *Exercises in classical ring theory* (2nd ed.) (Problem Books in Mathematics). Springer.

SIM3008 GROUP THEORY

The three isomorphism theorems. Cyclic groups. Direct product of groups. Introduction to the three Sylow's Theorem. Classification of groups up to order 8. Finitely generated abelian groups. Nilpotent groups and Soluble groups

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:
1. Ledermann, W., Weir, A. J., & Jeffery, A. (1997). Introduction to group theory (2nd ed.). Addison Wesley Pub. Co.
2. Rotman, J. J. (2014). *An Introduction to the theory of groups* (4th ed.). New Work: Springer-Verlag.
3. Gallian, A. J. (2017). *Contemporary abstract algebra* (9th ed.). Brooks Cole.

SIM3009 DIFFERENTIAL GEOMETRY

Vector algebra on Euclidean space. Lines and planes. Change of coordinates. Differential geometry of curves. Frenet Equations. Local theory of surfaces in Euclidean space. First and second fundamental forms. Gaussian curvatures and mean curvatures. Geodesics. Gauss-Bonnet Theorem.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English
Soft Skills:
CS3, CTPS3, LL2

References:

1. Lipschutz, M. (1969). *Schaum's outline of differential geometry*. McGraw-Hill.
2. Oprea, J. (2004). *Differential geometry and its applications* (2nd ed.). Prentice Hall.
3. Kuhnel, W. (2005). *Differential geometry: curves, surfaces, manifolds* (2nd ed.). Amer. Math. Soc.
4. Abate, M., & Tovena, F. (2012). *Curves and Surfaces*. Springer.
5. Pressley, A.N. (2010). *Elementary differential geometry*. Springer.

SIM3010 TOPOLOGY

Topological Spaces. Continuity, connectedness and compactness. Separation axioms and countability. Metric spaces. Product spaces.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:

1. Armstrong, M.A. (2010). *Basic topology* (Undergraduate Texts in Mathematics). Springer.
2. Munkres, J. (2000). *Topology* (2nd ed.). Prentice Hall Inc.
3. McCluskey, A., & McMaster, B. (2014). *Undergraduate topology: A working textbook*. Oxford University Press.

SIM3011 COMPLEX ANALYSIS

Taylor and Laurent series. Singularities and zeroes. Residue Theory. Evaluation of certain Integrals. Arguments Principle, Rouche's theorem. Maximum Modulus Principle. Infinite Products. Entire Functions.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:

1. John H. Mathews, & Russell W. Howell (2012). *Complex analysis for mathematics and engineering* (6th ed.). Jones & Bartlett Pub. Inc.
2. Saff, E. B., & Snider, A. D. (2003). *Fundamental of complex analysis.* Pearson Education Inc.
3. Ali, Rosihan M., & Ravichandran, V. (2008). *Complex Analysis*. Penerbit USM.
4. Markushevich, A. I. (1985). *Theory of functions of complex variables.* Chelsea Publ. Co.
5. Brown, J., & Churchill, R.V. (2013). *Complex variables & applications* (9th ed.). McGraw Hill.

SIM3012 REAL ANALYSIS

Riemann integral. Integrable functions. Properties of the Riemann integral. Integration in relation to differentiation. Differentiation of integrals. Improper integrals. Sequences and series of functions. Pointwise and uniform convergence. Properties of uniform convergence. Superior limit and inferior limit. Power series, radius of convergence. Taylor series.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References:

1. Witold A.J. Kosmala (2004). *A friendly introduction to analysis: Single and multivariable* (2nd ed.). Pearson International.
2. Schroder, B. S (2008). *Mathematical analysis: A concise introduction.* John-Wiley.
3. Richardson, L. F. (2008). *Advanced calculus: An introduction to linear analysis.* John-Wiley.
4. Lay, S.R. (2014). *Analysis with an introduction to proof* (5th ed.). Pearson.
5. Pedersen, S. (2015). *From calculus to analysis.* Springer.

SIM3013 PROBABILISTIC METHODS IN COMBINATORICS

The probabilistic method and its applications in combinatorics. The topics are selected from: The basic probabilistic methods applied on graphs, tournaments, and set systems; the use of linearity of expectation for Hamiltonian paths and splitting graphs; alterations for lower bound of Ramsey numbers, independent sets, packing and recolouring; the second moment methods; random graphs – threshold functions, subgraphs, clique number and chromatic number; the Lovász Local Lemma and its applications.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References:

1. Alon, N, & Spencer, J. (2008). *The probabilistic method* (3rd ed.). Wiley.
2. Janson, S., Luczak, T., & Rucinski, A. (2000). *Random graphs*. Wiley.
3. Matousek, J., & Nesetril, J. (1998). *Invitation to discrete mathematics*. Oxford University Press.
4. Molloy, M., & Reed, B. (2002). *Graph colouring and the probabilistic method.* Springer.
5. Lovász, L., Ruzsa, I., & Sós, Vera T. (Eds.). (2013). *Erdös Centennial*. Springer.

SIN1001 INTRODUCTION TO COMPUTING

MATLAB - Matlab environment, matrices, constants and variables, operation, built-in functions, output format, plot graphs, expressions and logical data, branches and loops, scripting, user-defined functions. Application of selected mathematical problems.

Assessment
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CTPS3, LL2

References:
1. Craig S. Leng. (2013). *Learning to program using MATLAB.* John Wiley & Sons, Inc.
2. Stephen J. Chapman. (2016). *MATLAB programming for engineers.* Cengage Learning.
3. *MATLAB ® primer R2018a*. (2018). MathWorks, Inc.
4. Alfio Quarteroni, Fausto Saleri, & Paola Gervasio (2010). *Scientific Computing with MATLAB and Octave.* Berlin Heidelberg: Springer-Verlag.
5. Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Kevin R. Coombes, John E. Osborn, & Garrett J. Stuck. (2006). *A guide to MATLAB ® for beginners and experienced users.* Cambridge University Press.

SIN1002 INTRODUCTION TO WORKSHEETS

Basics of Spreadsheet, entering labels, numbers and formulae. Absolute & relative addressing, Excel functions. Graph plotting, use of solvers. Applications to some selected mathematical problems

Assessment
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CTPS3, LL2

References:
1. Ronald W. Larsen. (2011). *Engineering with Excel*. Upper Saddle River, NJ: Pearson Prentice Hall.
2. S. C. Bloch, & Sylvan Charles Bloch. (2003). *Excel for engineers and scientists.* John Wiley & Sons.
3. E. Joseph Billo. (2007). *Excel for scientists and engineers: Numerical methods.* Wiley-Interscience.
4. Bernard V. Liengme. (1997). *A guide to Microsoft Excel for scientists and engineers*. London: Arnold.

SIN1003 MATHEMATICAL METHODS I

First order ODE: Definitions, solution concepts, valid solution intervals. Solutions to variable separable equations, linear equations, Bernoulli, exact and non-exact, homogeneous equations. Some applications of first order ODE.

Linear ODE with second and higher order: Definitions, solution concepts, linear independence, Wronskian. Solution to homogeneous and non-homogeneous equations. Method of undetermined coefficient, Variation of parameters, Series solution of ordinary differential equations, Frobenius's method, Legendre and Bessel's equations. Some applications of second order ODE.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

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Medium of Instruction:
English

Soft Skills:
CS2, CTPS3, LL2

References:
1. William F. Trench. (2013). *Elementary differential equations.* Retrieved from: http://ramanujan.math.trinity.edu/wtrench/texts/TRENCH_DIFF_EQNS_I.PDF
2. Paul Blanchard, Robert L. Devaney, & Glen R. Hall. (2012). *Differential equations* (4th ed.). Cengage.
3. James C. Robinson. (2004). *An introduction to differential equations*. Cambridge University Press.

SIN2001 MATHEMATICAL METHODS II

Computer arithmetic: floating-point numbers, round off error, machine precision, overflow/underflow, numerical cancellation, truncation error.

Taylor polynomial and limits.

Interpolation: Lagrange interpolation, Divided differences, Hermite interpolation, cubic spline interpolation

Roots of nonlinear equation: bisection method, fixed-point iteration, Newton – Raphson method, secant method.
Numerical differentiation: Forward, backward and central finite difference.

Numerical Integration: Rectangular, trapezoidal, Simpson's, Romberg's. Composite methods.

System of linear equations. Matrix factorization, LU factorization.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
C3, TS2, CTPS3, LL2

References:
1. Atkinson, K. E. (1993). *Elementary numerical analysis* (2nd ed.). John Wiley & Sons.
2. Burden, R. L., & Faires, J. D. (2012). *Numerical analysis* (7th ed.). USA: Brooks/Cole.
3. Brian Bradie. (2006). *A friendly introduction to numerical analysis*. New Jersey: Pearson Education.

SIN2002 STRUCTURED PROGRAMMING

Algorithms: Structured programming – sequence, decision and loops. Object-oriented design.

C++ programming: fundamental data types – int, double, char. C++ operators, precedence. Pre-processor directives. In-Built functions. User-defined functions – pass by value, pass by reference. One-dimensional and two-dimensional arrays.
Introduction to user-defined data types – structures and classes.

Applications to numerical methods: integer- and floating point arithmetic, root-finding, solution of ordinary differential equations. Use of random number generators.

Assessment
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
English

Soft Skills:
CS3, CPTS3, LL2

References:

1. John R. Hubbard. (2014). *Programming with C++* (2nd ed.), McGraw-Hill.
2. James P. Cohoon, & Jack W. Davidson. (2002). *C++ program design: An introduction to programming and object-oriented design* (3rd ed.). McGraw-Hill.
3. Harvey Deitel, & Paul Deitel. (2003). *C++ how to program* (4th ed.). Pearson.
4. Frank L. Friedman, & Elliot B. Koffman. (2011). *Problem Solving, abstraction and design using C++* (3rd ed.). Addison-Wesley.
5. Rubin H. Landau. (2008). *A survey of computational physics: Introductory computational science*. Princeton Press.

SIN2003 BASIC OPERATIONAL RESEARCH

Introduction to the problems in operational research, modelling, formulation and examples. Linear programming, transportation and assignment problems. Integer programming, game theory and dynamic programming.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References:

1. H.A. Taha. (2015). *Introduction to operational research.* John Wiley.
2. W.L. Winston. (1994). *Operational research: applications and algorithm.* Duxbury Press.
3. F.S. Hillier, & G.J. Lieberman. (2011). *Introduction to operations research.* McGraw-Hill.
4. B. Van Der Veen. (1967). *Introduction to the theory of operational Research*. London: Cleaver-Hume P.

SIN2004 PARTIAL DIFFERENTIAL EQUATIONS

Fourier series. Introduction to partial differential equations, Method of characteristic, Separation of variables, Laplace transform method.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CS3, CTPS3, LL2

References.

1. D. G. Zill, & M. R. Cullen. (2005). *Differential equations with boundary-value problems* (7th ed.). Brooks/Cole.
2. E. Kreyzig. (2006). *Advanced engineering mathematics* (9th ed.). John Wiley & Sons.
3. E. Butkov. (1966). *Mathematical physics*. Addison-Wesley.
4. R. K. Nagle, & E. B. Saff. (1996). *Fundamentals of differential equations and boundary value problems* (2nd ed.). Addison-Wesley.
5. W. E. Boyce, & R.C. *DiPrima.* (2011). *Elementary differential equations and boundary value problems* (8th ed.). John Wiley & Sons.

SIN2005 SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS

Systems of homogeneous linear first order differential equations with constant coefficients. Systems of non-homogeneous linear differential equations. Autonomous systems for linear and almost linear systems, and stability. Liapunov's method. Applications.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CS4, CTPS5, TS2, LL2

References.

1. William E. Boyce, & Richard C. Prima (2017). *Elementary differential equations and boundary value problems* (11th ed.) John Wiley & Sons, Inc.
2. Dennis G. Zill, & Michael R. Cullen. (2009). *Differential equations with boundary value problems* (7th ed.). Brooks/Cole, Cengage Learning.
3. R. Kent Nagle, Edward B. Saff, & Arthur David Snider. (2012). *Fundamentals of differential equations* (8th ed.). Pearson Education, Inc.
4. Dominic Jordan, & Peter Smith. (2007). *Nonlinear ordinary differential equations: An introduction for scientists and engineers* (4th ed.). Oxford University Press.
5. Lawrence Perko. (2001). *Differential equations and dynamical systems* (3rd ed.). New York: Springer-Verlag, Inc.

SIN2006 VECTOR ANALYSIS

Scalar and vector fields. Dot and cross products. Scalar and vector triple products.
Vector differentiation (ordinary and partial). Space curves. Displacement, velocity, and acceleration. Gradient. Divergence. Curl.
Line integrals and work. Conservative vector fields – path independence, potential functions. Surface integrals. Green's theorem. Stokes' theorem. Volume integrals. Divergence theorem of Gauss.
Curvilinear coordinates – polar, cylindrical, spherical coordinates.

Assessment
Continuous Assessment: 40%
Final Examination: 60%
Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CS3, CTPS3, LL2

References:
1. Susan Jane Colley. (2012). *Vector calculus* (4th ed.). Pearson Education, Inc.
2. Donald Edward Bourne, & P. C. Kendall. (2018). *Vector analysis and Cartesian tensors* (3rd ed.). CRC Press.
3. George B. Thomas, Jr., Maurice D. Weir, & Joel Hass. (2018). *Thomas' calculus early transcendentals* (14th ed.) (Chap. 12-16). Pearson Education, Inc.
4. Seymour Lipschutz, Dennis Spellman, & Murray. R. Spiegel, (2009). *Schaum's outline of vector analysis.* McGraw-Hill Companies, Inc.
5. Pramod S. Joag. (2016). *An introduction to vectors, vector operators and vector analysis.* Cambridge University Press.

SIN2007 MANAGEMENT MATHEMATICS

Output function: Theory and some concepts. Break even model. Optimization profit for monopoly and oligopoly market. Inventory model. EOQ Model, reordering point, finite input rate, shortage and quantity discount. Probabilistic Model, safety stock and efficiency level.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia

Soft Skills:
CS3, CTPS3, LL2

References:
1. Baldani, J. (1996). *Mathematical economics*. The Dryden Press.
2. Davies, K.R., McKeown, P.G., & Rakas, T.R. (1986). *Management science: An introduction*. Kent Publishing Company.
3. Winston, W.L. (1994). *Operations research: applications and algorithms* (3rd ed.). Duxbury Press.
4. Hillier, Frederick S. (1995). *Introductory to operations research* (6th ed.). New York: McGraw-Hill.
5. Taha, Hamdy A (2011). *Operations research: An introduction* (8th ed.). New York: Mcmillan.
6. C.D.J. Waters. (2003). *Inventory control and management*. Canada: University of Calgary.

SIN2008 OPTIMIZATION TECHNIQUE

Unconstraint optimization, necessary and enough conditions for optimality. Constraint optimization. Type of constraint. Special technique for solving non-linear problem.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CTPS3, LL2, CS3

References
1. Philip E. Grill, Walter Murray, & Margaret H. Wright. (1982). *Practical Optimization.* Emerald Group Publishing Limited.
2. C. Mohan, & Kusum Deep. (2009). *Optimization techniques.* New Age Science.
3. L. R. Foulds. (1981). *Optimization techniques an introduction.* Springer.
4. Singiresu S. Rao. (2009). *Engineering optimization: Theory and practice*. John Wiley & Sons, Inc.

SIN2009 COMPUTER GRAPHICS

Introduction to C++ Compiler and OpenGL. Plane geometric coordinate. Coordinate transformations. Polynomial interpolation. Continuity. Curve and surface design.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/ English

Soft Skills:
CS3, TS3, LL2, LS2

References
1. D. F. Rogers, & J. A. Adams. (1990). *Mathematical elements for computer graphics* (2nd ed.). McGraw Hill.
2. Donald Hearn, & M. Pauline Baker. (1994). *Computer graphics*. Prentice Hall.
3. F. S. Hill, Jr. (2001). *Computer graphics using OpenGL* (2nd ed.). Prentice Hall.
4. Zhigang Xiang, & Roy Plastock. (2000) *Schaum's outline of theory and problems of computer graphics* (2nd ed.). McGraw-Hill.
5. Richard S. Wright, Jr., & Michael Sweet. (2000). *OpenGL superbible* (2nd ed.). Waite Group Press.

SIN3001 INTRODUCTION TO QUANTUM MECHANICS WITH COMPUTERS

Introduction to Quantum mechanics. The wave-function and its interpretation. One-dimensional time-independent Schrodinger equation. Solution for the cases of the infinite- and finite-square well, harmonic oscillator potential and free-particle case. Formalism of quantum mechanics. Two- and three-dimensional systems. The hydrogen atom. The concept of spin.

Assessment
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References
1. David J. Griffiths, & Darrell F. Schroeter. (2018). *Introduction to quantum Mechanics* (3rd ed.). Cambridge University Press.
2. A. F. J. Levi. (2006). *Applied quantum mechanics* (2nd ed.). Cambridge University Press.
3. Joshua Izaac, & Jingbo Wang. (2018). *Computational quantum mechanics.* Springer Nature Switzerland AG.
4. Paul R. Berman. (2018). *Introductory quantum mechanics.* Springer International Publishing AG.
5. Nelson Bolivar, & Gabriel Abelian. (2018). *Quantum mechanics: Axiomatic theory with modern applications.* Apple Academic Press, Inc.

SIN3002 CRYPTOGRAPHY

Basic concept of cryptography, data security, complexity theory and number theory. Encryption algorithms: Secret key cryptography, public key cryptography, hash functions. Quantum cryptography. Applications of cryptographic algorithms.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CS3, CTPS3, LL2

References
1. Trappe, W., & Washington, L.C. (2014). *Introduction to cryptographywith coding theory*. Pearson Prentice Hall.
2. Stallings, W. (2006). *Cryptography and network security: Principles and practice* (4th ed.). Englewood Cliffs (NJ): Prentice Hall.
3. Schneider, B. (1996). *Applied cryptography* (2nd ed.). New York: John Wiley and Sons.
4. Martin, M.K. (2012). *Everyday cryptography*. Oxford University Press.
5. Stinson, D.R. (1995). *Cryptography: Theory and practice*. CRC Press.

SIN3003 COMPUTATIONAL FLUID DYNAMICS

Derivation of conservation equations for mass, momentum and energy. Scaling and simplification of Navier-Stokes equation to Bernoulli's equation, Stokes' equation and boundary layer equation. Initial- and boundary-conditions. Simple analytical solutions and approximate solutions. Numerical solutions: finite-element, finite-difference and finite-volume methods.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CS4, CTPS5, TS2, LL3

References
1. Yunus A. Chengel, & John Cimbala. (2014). *Fluid mechanics*. McGraw- Hill.
2. S. M. Richardson. (1989). *Fluid mechanics*. Hemisphere Pub. Corp.
3. A. R. Peterson. (1987). *A first course in fluid dynamics.* CUP.
4. G. K. Batchelor. (1967). *An introduction to fluid dynamics.* CUP.
5. J. D. Anderson. (1995). *Computational fluid dynamics*. McGraw- Hill.
6. Joel H. Ferziger, & Milovan Peric. (2011). *Computational methods for fluid dynamics*. Springer.

SIN3004 ANALYSIS OF MATHEMATICAL MODELS

Building of mathematical models: identifying variables, obtain relationship between variables – ordinary differential equations and systems of odes. Analysis of models analytically and qualitatively. Bifurcations. Phase plane analysis, stability.

Assessment
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
Bahasa Malaysia/ English

Soft Skills:
CS4, CTPS5, TS2, LL2

References
1. Steven H. Strogatz. (2018). *Nonlinear dynamics and chaos* (2nd ed.) Westview Press.
2. Dominic Jordan, & Peter Smith. (2007). *Nonlinear ordinary differential equations: An introduction for scientists and engineers* (4th ed.). Oxford University Press.
3. Lawrence Perko. (2001). *Differential equations and dynamical systems* (3rd ed.). New Work: Springer Verlag, Inc.
4. Stephen Wiggins. (2003). *Introduction to applied nonlinear dynamical systems and chaos* (2nd ed.). New York: Springer-Verlag, Inc.
5. Morris W. Hirsch, Stephen Smale, & Robert L. Devaney. (2013). *Differential equations, dynamical systems & an introduction to chaos* (3nd ed.). Waltham, MA: Elsevier, Inc.

SIN3005 NUMERICAL METHODS AND ANALYSIS

Approximation methods: Discrete least square approximation, orthogonal polynomials, Chebyshev polynomials.

Eigenvalue problem: Power method, Householder's methods. The QR algorithm.

Initial value problem of Ordinary Differential Equations:
Euler's method, higher order Taylor method, Runge-Kutta methods. Multistep methods. Multistep methods. Convergence and stability analysis, error control.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, LL2

References
1. K.E. Atkinson. (1993). *Elementary numerical analysis* (2nd ed.). John Wiley & Sons.
2. R.L. Burden, & J.D. Faires. (2001). *Numerical analysis* (7th ed.). USA: Brooks/Cole.
3. Brian Bradie. (2011). *A friendly introduction to numerical analysis.* New Jersey: Pearson Education.

SIN3006 PRODUCTION AND INVENTORY SYSTEM

The importance of inventory in management. Advanced EOQ models. Inventory model for time-dependent demand: linear increase or decrease cases. Exact and approximate methods by minimizing ordering and holding costs. Applications to real-world problems.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia

Soft Skills:
CS3, CTPS3, LL2

References

1 . Hamdy A. Taha. (2011). *An introduction to operational research* (8th ed.). New York: Mcmillan.
2. E. Naddor. (1966). *Inventory systems*. J. Wiley.
3. Hadley G., & Whitin T.M. (1963). *Analysis of inventory systems*, Englewood Cliggs, New Jersey: Prentice-Hall, Inc.
4. C. D. J. Waters. (2003). *Inventory control and management.* Canada: University of Calgary..
5. Hillier, Frederick S. (2005). *Introductory to operations Rresearch* (8th ed.). New York: McGraw-Hill.

SIN3007 HEURISTIC METHODS

Introduction. Descent Heuristics: random solutions, greedy solutions, exchange heuristics. Improvement Heuristics: Local optimization, iterated local search, simulated annealing, tabu search. Artificial Intelligence: Genetic algorithm, evolutionary algorithm, artificial neural network. Evaluating heuristics. NP Completeness.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CTPS4, LL2

References

1. S. S. Skeina, The Algorithm Design, Springer-Verlag, 1997.
2. Ashraf Aboshosha, Yaser KhalifaGenetic Algorithms Theories and Applications: Evolutionary Algorithms, Optimization Techniques, Heuristics, Artificial Intelligence, Biologically inspired Algorithms,LAP LAMBERT Academic Publishing, 2012.
3. Z. Michalewicz, D.B. Fogel, How To Solve It: Modern Heuristics, Springer-Verlag, 2005.
4. I.Osman and P. Kelly, Met-Heuristics: Theory and Applications: Kluwer, 1996.
5. E. Rich and K. Knight, *Artificial Intelligence*, International Edition, McGraw-Hill Inc., 1991.
6. Z. Michalewicz, *Genetic Algorithms + Data Structures = EvolutionProgrammes*, Springer-Verlag, 1992.

SIN3008 MATHEMATICAL PROGRAMMING

The matrix of simplex theory and sensitivity analysis. Parametric linear programming. Revised simplex method. The technique of upper bounded variables. Karmarkar's interior point algorithm. Dantzig-Wolf decomposition principle. Pure, mixed and binary (0-1) integer programming. Cutting plane. Multi-objectives linear goal programming. Graphical. Simplex iterative and modified methods.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CS4, CTPS3, LL2, TS2

References

1. Markland, R.E & Sweigart, J.R, Quantitative Methods: Applications to Managerial Decision Making , John Wiley & Sons. 1987
2. Moore, L.J, Lee, S.M & Taylor, B.W, Management Science, 4th edition, Allyn and Bacon. 1993
3. Taha, H.A, Operations Research: An Introduction, 5th edition, Macmillan Pub. Co. (edisi Bahasa Malaysia oleh USM-DBP). 1992
4. Winston, W.L, Operations Research: Applications and Algorithms, Third Edition. Duxbury Press, 2013.

SIN3009 INDUSTRIAL OPERATIONAL RESEARCH

Definition of a network. Node, branch, path, chain, cycle and circuit. Examples of network flow model. Network flow: Shortest path, minimum spanning tree, maximum flow and minimum cost maximum flow. Activity Network: Critical path model method: Earliest and Latest time, slack activities and critical path. Project valuation. Optimal path. Project scheduling. Network model as an example of a linear programming model.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CS4, CTPS3, LL2, TS2

References

1. Groebner, D.F & Shannon, P.W (1991), Introduction to Management Science, International Edition, Dallen-Macmillan-Maxwell.
2. Lipin, L.L (1994), Quantitative Methods for Business Decisions (with cases), 6th edition. Dryden Press.
3. Taylor, B.W (1993), Introduction to Management Science, Allyn and Bacon.
4. Winston, W.L, Operations Research: Applications and Algorithms, Third Edition. Duxbury Press, 2013.

SIN3010 COMPUTATIONAL GEOMETRY

Vector algebra, introduction to differential geometry, design for curves, design surfaces for Bezier surfaces, triangular Bezeir surfaces, B-Spline, rational Bezier and Coons surfaces.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CTPS3, LL2, CS2, TS2

References

1. Hill, F.S. (2014). *Computer graphics using OpenGL*, Prentice Hall.
2. Farin, G. (1997). *Curves and surfaces for computer aided geometric design.* Boston: Academic Press.
3. Hoschek, J., & Lasser, D. (1993). *Fundamentals of computer aided geometric design.* Ak Peters Ltd.
4. Farin, G., Hoschek, J., & Kim., S.M. (2012). *Handbook of computer aided geometric design*. North Holland: Elsevier.
5. Patrikalakis, N. M., & Maekawa, T. (2011). *Shape interrogation for computer aided design and manufacturing.* Springer.

SIN3011 SCIENTIFIC COMPUTING

Functions, arrays, structures, pointers, strings, classes in C++. Computation of special functions, solutions of linear systems of equations and of specific partial differential equations in C++.

Assessment
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, TS2, LL2, LS2

References

1. D. S. Malik. (2015). *C++ Programming program design including data structures* (7th ed.). Cengage Learning.
2. Tony Gaddis, Judy Walters, & Godfrey Muganda. (2017). *Starting with C++ early objects* (9th ed.). Pearson Education, Inc.
3. Ward Cheney, & David Kincaid. (2008). *Numerical mathematics and computing* (6th ed.). Thomas Brooks/Cole.
4. Richard L. Burden, & J. Douglas Faires. (2011). *Numerical analysis.* Brooks/Cole, Cengage Learning.
5. Joe Pitt-Francis, & Jonathan Whiteley. (2017). *Guide to scientific computing in C++* (2nd ed.). Springer International Publishing AG.

SIN3012 MECHANICS

Newton's laws of motion, central forces, motion in a plane (cartesian, polar coordinates), conservative forces, conservation of energy and momentum, small oscillations, stable and unstable equilibriums.
Lagrangian mechanics: constraints, generalized coordinates, principle of least action, Euler-Langrange equations.

Assessment
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS4, LL2

References

1. Herbert Goldstein, Charles Poole, & John Safko. (2014). *Classical mechanics* (3rd ed.). Pearson Education Limited.
2. Grant R. Fowles, & George L. Cassiday. (2005). *Analytical mechanics* (7th ed.). Brook/Cole.
3. Tai L. Chow. (2013). *Classical mechanics* (2nd ed.). Taylor & Francis Group. LLC.
4. Stephen T. Thornton, & Jerry B. Marion. (2004). *Classical dynamics of particles and systems* (5th ed.). Belmont, CA: Brooks/Cole.
5. Tom W. B. Kibble, & Frank H. Berkshire. (2004). *Classical mechanics* (5th ed.). IImperial College Press.

SIN3013 FOURIER AND WAVELETS ANALYSIS

Functions and Function Spaces, Fourier Transform, Sampling, Orthogonal Wavelet Systems, Multi-resolution Analysis (MRA), Discrete Wavelet Transform, Continuous Wavelet Transform, Wavelet Toolbox, Applications to data compression, de-noising and others.

Assessment
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
English

Soft Skills:
CTPS3, LL2

References

1. Gilbert Strang, & Truong Nguyen. (1996). *Wavelets and filter banks* (2nd ed.). Wellesley College.
2. Albert Boggess, & Francis J. Narcowich. (2011). *A first course in wavelets with Fourier analysis* (2nd ed). Wiley.
3. Stéphane Mallat. (1999). *A wavelet tour of signal processing* (2nd ed.). Academic Press.
4. James S. Walker. (2008). *A primer on wavelets and their scientific applications* (2nd ed.). Chapman & Hall/CRC.
5. *Wavelet toolbox user's guide.* 2006. The MathWorks, Inc.

SIN3014 INDUSTRIAL TRAINING

Candidates are required to spend minimum 10 weeks working with selected companies in selected areas of industry.

Assessment
Continuous Assessment: 100% S/U

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CS4, CTPS3, TS2, LL2, EM2, LS3

References
University of Malaya Guidebook for Industrial Training

SIN3015 MATHEMATICAL SCIENCE PROJECT

Subject to supervising lecturer

Assessment
Continuous Assessment: 100%

Medium of Instruction:
Bahasa Malaysia/English

Soft Skills:
CS4, CTPS4, TS2, LL2
References
Refer to the lecturer.

SIQ1001 INTRODUCTION TO ACCOUNTING

Basic principles of accounting – including the role of accounting standards. Different types of business entity. Basic structure of company accounts. Interpretation and limitation of company accounts.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS2, CTPS1, LL1

References:

1. Reimers, Jane L. (2007). *Financial accounting*. Pearson Prentice Hall.
2. Hermanson, R.H., & J.D. Edwards. (1995). *Financial accounting: A business perspective* (6th ed.). Irwin.
3. Hoggett, J., & L. Edwards. (1996). *Financial accounting in Australia* (3rd ed.). Queensland: John Wiley and Sons.
4. Kirkwood, L., C. Ryan, J. Falt, & T. Stanley. (1993). *Accounting: An Introductory Perspective* (3rd ed.). Melbourne: Longman Cheshire.
5. Meigs, W.B., & R.F. Meigs. (1995). *Financial accounting* (8th ed.) New York: McGraw Hill.

SIQ2001 MICROECONOMICS

Fundamental principles of economics; price theory which covers the demand model, supply model and equilibrium point; shape of demand curve and consumer behavior; substitution effects and income; shape of supply curve and behavior of firms; theory of production and cost of production; analysis of competitive markets in the short term; monopoly and oligopoly.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS2, CTPS2, LL1

References:

1. Katz, Michael L., & Rosen, Harvey S. (1999). *Microeconomics* (2nd ed.). McGraw Hill.
2. Sloman, J., Hinde, K. and Garratt, D. (2013). *Economics for business* (6th ed.). Pearson.
3. Begg, D. (2012). *Economics for business*. McGraw Hill Higher Education.
4. Bade, R., & Parkin, M. (2014). *Foundation of economics.* Pearson.

SIQ2002 MACROECONOMICS

Macroeconomic issues and problems; fundamental concepts of national income; method of calculating national income; simple Keynesian model; derivation of IS curve, LM curve, aggregate demand curve, and aggregate supply curve; relationship between interest rates, monetary demand, consumption and investments; relationship between price levels, monetary demand, aggregate demand and aggregate supply in a Keynesian model.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS2, CTPS2, LL1

References:

1. Richard T. Froyen. (2002). *Macroeconomics: Theories and policies* (7th ed.). Prentice Hall.
2. Case, Karl E. (2007). *Principles of macroeconomics*. Pearson Prentice Hall.
3. Sloman, J., Hinde, K., & Garratt, D. (2013). *Economics for business* (6th ed.). Pearson.
4. Bade, R., Parkin, M. (2014). *Foundation of economics*. Pearson.

SIQ2003 FINANCIAL MATHEMATICS AND DERIVATIVES

Time Value of Money: simple interest, compound interest, present and accumulated values, nominal rate of interest, force of interest, equation of value.

Annuities: annuity immediate, annuity due, perpetuity, m-thly annuity, continuous type annuity, deferred annuities, varying annuities.

Instalments: Amortization, sinking funds, amortization with continuous payments.

Bonds: Types of bonds, pricing formula, callable and serial bonds, other securities.

Cash flows: Discounted cash flows, internal rate of return, money-weighted and time weighted rate of return.
Term Structure of Interest Rate: Yield curves, spot and forward rates, duration, convexity, immunization.

Introduction to Derivatives: Forward and futures, short and long positions, arbitrage, put and call options, put-call parity, swaps, put-call parity, hedging.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. Broverman, S. A. (2010). *Mathematics of investment and credit* (5th ed.). Actex Publications.
2. Kellison, G. (2008). *Theory of interest* (3rd ed.). McGraw-Hill.
1. McDonald, R. L. (2012). *Derivatives markets* (3rd ed.). Prentice Hall.
2. McCutcheon, J. J., & Scott W. F.(1989*). Introduction to the mathematics of finance.* Butterworth-Heinemann.

SIQ3001 ACTUARIAL MATHEMATICS I

Survival distributions: lifetime probability functions, force of mortality, moments and variance, parametric survival models, percentiles, recursions, fractional ages, select and ultimate life tables.
Life Insurances: continuous type life insurances, discrete type life insurances, probabilities, percentiles, recursive formula, m-thly payments, varying insurance.

Life Annuities: continuous type life annuities, discrete type life annuities, expectation and variance, probabilities, percentiles, recursive formulas, m-thly payments, varying annuities.

Premiums: expectation and variance of loss random variable, fully continuous and discrete premiums, semicontinuous premiums, m-thly premiums, gross premiums, probabilities, percentiles.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. Bowers, N., Gerber, H., Hickman, J., Jones, D., & Nesbitt, C. (1997). *Actuarial mathematics* (2nd ed.). Society of Actuaries.
2. Dickson, D. C., Hardy, M. R., & Waters, H. R. (2013). *Actuarial mathematics for life contingent risks*. Cambridge University Press.
3. Cunningham, R. J. (2011). *Models for quantifying risk*. Actex Publications.
4. Promislow, S. D. (2011). *Fundamentals of actuarial mathematics*. John Wiley & Sons.

SIQ3002 PORTFOLIO THEORY AND ASSET MODELS

Utility theory: Features of utility functions, expected utility theorem, risk aversion.

Stochastic dominance: Absolute, first and second order stochastic dominance.

Measures of investment risk: Variance, semi-variance, probability of shortfall, value-at-risk, expected shortfall.

Portfolio theory: Mean-variance portfolio, diversification, efficient frontier, optimal portfolio selection, efficient portfolio identification.

Models of asset returns: Single-index models, fitting a single index model, multi-index models.

Asset Pricing Model: Capital Asset Pricing Model, Arbitrage Pricing Theory.

Efficient market hypothesis

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. Elton, E. J., Gruber, M. J., Brown, S. J., & Goetzmann, W. N. (2014). *Modern portfolio theory and investment analysis* (9th ed.). John Wiley & Sons.
2. Bodie, Z., Kane, A., & Marcus, A. J. (2013). *Investment* (10th ed.). McGraw-Hill/Irwin.
3. Francis, J.C., & Kim, D. (2013). *Modern portfolio theory: Foundations, analysis, and new developments*. John Wiley & Sons.
4. Joshi, M. S., & Paterson, J. M. (2013). *Introduction to mathematical portfolio theory*. Cambridge University Press.
5. Bodie, Z., Merton, R.C., and Cleeton, D (2008). Financial Economics, 2/E. Prentice Hall.

SIQ3003 ACTUARIAL MATHEMATICS II

Reserves: fully continuous and discrete reserves, semicontinuous reserves, prospective and retrospective reserves, expense reserves, variance of loss, special formulas, recursive formulas.

Markov Chains: discrete and continuous Markov chains, Kolmogorov's forward equations, premiums and reserves using Markov chains, multiple-state models.

Multiple Decrement Models: discrete and continuous decrement models, probability functions, fractional ages, multiple and associated single decrement tables, uniform assumption.

Multiple Life Models: joint life, last survivor and contingent probabilities, moments and variance of multiple life models, multiple life insurances and annuities.

Unit-linked contracts and profit tests: Emerging costs, profit testing for conventional and unit-linked contracts.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. Bowers, N., Gerber, H., Hickman, J., Jones, D., & Nesbitt, C. (1997). *Actuarial mathematics* (2nd ed.). Society of Actuaries.
2. Dickson, D. C., Hardy, M. R., & Waters, H. R. (2013). *Actuarial mathematics for life contingent risks*. Cambridge University Press.
3. Cunningham, R. J. (2011). *Models for quantifying risk*. Actex Publications.
4. Promislow, S. D. (2011). *Fundamentals of actuarial mathematics*. John Wiley & Sons.

SIQ3004 MATHEMATICS OF FINANCIAL DERIVATIVES

Introduction to derivatives: Call and put options, forwards, futures, put-call parity.

Binomial models: one-step model, arbitrage, upper and lower bounds of options prices, construction of multi-step binomial tree.

The Black-Scholes model: Pricing formula, options Greeks, trading strategies, volatility.

Hedging: Market making, delta hedging, Black-Scholes partial differential equation, delta-gamma-theta approximation
Exotic options: Asian options, barrier options, compound options, gap options, all-or-nothing options, exchange options.

Brownian motion and Itô's lemma: Brownian motion, Itô's lemma, Sharpe ratio, martingale representation theorem

Term structure of interest rate: Vasicek model, Cox-Ingersoll-Ross model, Black-Derman-Toy binomial tree

Models for credit risk: Structural, reduced form and intensity based models, Merton model, valuing credit risky bonds

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. McDonald, R. L. (2013). *Derivatives markets* (3rd ed.). Pearson Education.
2. McDonald, R. L. (2009). *Fundamentals of derivatives markets*. Pearson Education.
3. Hull, J. C. (2012). *Option, futures and other derivatives* (8th ed.). Pearson Education.
4. Hull, J. C. (2014). *Fundamentals of futures and options markets* (8th ed.). Pearson Education.
5. Weishaus, A. (2012). *ASM study manual for Exam MFE/Exam 3F: financial economics* (8th ed.).

SIQ3005 LIFE INSURANCE AND TAKAFUL

Insurance products and unit-linked insurance; Group Life insurance; Operation of a Life Insurance company: underwriting, claims, marketing and distribution methods; Profit testing ; Takaful insurance; Regulations: Insurance Act, taxation and role of Bank Negara.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS2, CTPS1, LL2

References:

1. Fisher, Omar Clark. (2013). *A takaful primer: Basics of Islamic insurance*. Thomson Reuters.
2. Archer, S., Karim, R. A. A., & Nienhaus, V. (Eds.). (2011). *Takaful Islamic insurance: Concepts and regulatory issues* (Vol. 764). John Wiley & Sons.
3. Yusof, Mohd Fadzli (2006). *Mengenali takaful.* IBS Buku Sdn Bhd.
4. Gonulal, S. O. (Ed.). (2012). *Takaful and mutual insurance: Alternative approaches to managing risks.* World Bank Publications.

SIQ3006 RISK THEORY

Loss distributions: Claim frequency and claim severity distributions, creating new distributions, parameter estimation methods, goodness-of-fit tests, risk sharing arrangements.

Aggregate risk models: Individual risk models, collective risk models, reinsurance.

Run-off triangle: Chain ladder method, average cost per claims method, Bornheutter-Ferguson method.

Credibility theory: Bayesian credibility methods, credibility premium formula, empirical Bayes credibility theory.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS2, CTPS3

References:

1. Klugman, S. A., Panjer, H. H., & Willmot, G. E. (2012). *Loss models: from data to decisions* (Vol. 715). John Wiley & Sons.
2. Cunningham, R. J. (2011). *Models for quantifying risk*. Actex Publications.
3. Dickson, D. (2010). *Insurance risk and ruin*. Cambridge University Press.
4. Tse, Y. K. (2009). *Nonlife actuarial models: Theory, methods and evaluation*. Cambridge University Press.

SIQ3007 INDUSTRIAL TRAINING

Subject to the training offered by the relevant company.

Assessment:
Continuous Assessment: 100%

Medium of Instruction:
English

Soft Skills:
CS4, CTPS3, TS3, LL2, KK1, EM2, LS1

SIQ3008 PENSION MATHEMATICS

Economic and social security; Pensions and their variants; Pension system in Malaysia; Employee Provident Fund (EPF); Social Security Organization (SOCSO); Government pension scheme; Annuity scheme; Modeling pension plans using mathematical software; International pension legislation and regulation; Malaysia regulatory framework related to retirement.

Assessment:
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. Anderson, A. W. (2006). *Pension mathematics for actuaries.* Actex Publications.
2. Asher, M. G. (1994). *Social security in Malaysia and Singapore: Practices, issues, and reform directions*. Malaysia: Institute of Strategic and International Studies.
3. Bakar, S. H. A., & Yunus, F. (2000). Social security policies in Malaysia: The Employees' Provident Fund (EPF) and Social Security Organisation (SOCSO). *Issues and Challenges of Social Policy East & West*, 187-219.
4. Malaysia.; International Law Book Services. Legal Research Board. (2013). *Undang-undang pencen di Malaysia: Hingga 10hb Mei 2013.* Petaling Jaya, Selangor Darul Ehsan: International Law Book Services.

SIQ3009 FOUNDATION OF ISLAMIC FINANCE

Introduction to Islamic finance and its practices; Riba, gharar and maisir; Musharkah, mudharabah and murabahah; Ijarah, salam and istisna'; Çomparison of Islamic and conventional financial systems; Islamic financial institutions and products, Islamic banking and takaful, Islamic investment instruments; Capital market in an Islamic framework, leasing, securitization and sukuk; Modeling Islamic financial products using mathematical software; Regulatory framework for Islamic financial institutions in Malaysia.

Assessment:
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:
1. Taqi Usmani, M. (1998). *An introduction to Islamic finance*. Arham Shamsi.
2. El-Gamal, M. A. (2006). *Islamic finance: Law, economics, and practice*. Cambridge University Press.
3. Iqbal, Z., & Mirakhor, A. (2011). *An introduction to Islamic finance: Theory and practice* (Vol. 687). John Wiley & Sons.
4. Mirakhor, A., & Krichene, N. (2014). *Introductory mathematics and statistics for Islamic finance*. John Wiley & Sons.
5. Hassan, M.K., Kayed, R.N., & Oseni, U.A. (2013). *Introduction to Islamic banking and finance: Principles and practice*. Pearson Education Limited.

SIQ3010 SURVIVAL MODEL

Estimation of lifetime distributions: lifetime distributions, cohort studies, censoring, Kaplan-Meier estimates, Cox regression model and its estimation.

Markov models: Multi-state Markov models, Kolmogorov forward equations, estimation of the force of mortality, estimation of multi-state model transition intensities.

Binomial and Poisson models of mortality: Binomial model of mortality, uniform and constant force of mortality assumptions, maximum likelihood estimator for the rate of mortality, Poisson models.

Graduation and statistical tests: methods of graduating crude estimates, Chi-square test, standardised deviation test, sign test, grouping of sign test, serial correlations test.

Exposed to risk: Exact exposed to risk, approximate exposed to risk using census data.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:
1. Elandt-Johnson, R. C., & Johnson, N. L. (1999). *Survival models and data analysis.* John Wiley.
2. Benjamin, B., & Pollard, J. H. (1993). *The analysis of mortality and other actuarial statistics.* Institute and Faculty of Actuaries.
3. London, Dick. (1998). *Survival models and their estimation*. ACTEX Publications.
4. Peter J. Smith. (2002). *Analysis of failure and survival data*. Chapman & Hall.
5. Collett, D. (2015). *Modelling survival data in medical research*. CRS Press.

SIT1001 PROBABILITY AND STATISTICS I

Properties of probability. Counting techniques. Conditional probability. Independent events. Bayes Theorem.

Discrete random variables. Mathematical Expectation. Discrete distributions: uniform, hypergeometric, Bernoulli, binomial, geometric, negative binomial and Poisson. Moment generating function.

Continuous random variables and its mathematical expectation. Continuous distributions: uniform, exponential, gamma, chi-squared and Normal distributions.

Distribution of function of one random variable.

Sampling distribution theory: Independent random variables. Distributions of sum of independent random variables. Random functions related to the normal distribution. Central limit theorem. Approximation for discrete distributions. Limiting moment generating functions.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS2, CTPS2, EM2

References:
1. R. V. Hogg, & E. A. Tanis. (2010). *Probability and statistical inference* (8th ed.). Pearson.
2. R. V. Hogg, J. McKean, & A. T. Craig. (2012). *Introduction to mathematical statistics* (7th ed.). Pearson.
3. H.J. Larson. (1982*). Introduction to probability theory and statistical inference* (3rd ed.). Wiley.

SIT2001 PROBABILITY AND STATISTICS II

Distributions of two and more dimensional random variables. Correlation coefficient. Conditional distributions. Bivariate normal distribution. Transformation of two random variables. Distributions of order statistics.

Biased and unbiased estimators. Method of moments. Method of maximum likelihood. Confidence interval for: mean, proportion and variance of single population; difference between two means, difference between two proportions and ratio of variances.

Hypothesis testing for: mean, proportion and variance of single population; difference between two means, difference between two proportions and ratio of variances. Chi-square goodness-of-fit tests and contingency tables.
Power of a statistical test. Best critical region. Likelihood ratio test. Chebyschev's inequality. Rao-Cramer's inequality. Convergence in probability and distribution. Asymptotic distribution of maximum likelihood estimator.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. R. V. Hogg, E. A. Tanis, & D. Zimmerman. (2015). *Probability and statistical inference* (9th ed.). Prentice Hall.
2. R. V. Hogg, J. W. McKean, & T.C. Craig. (2013). *Introduction to mathematical statistics* (7th ed.). Prentice-Hall.
3. D. Wackerly, W. Mendenhall, R. L. Scheaffer. (2008). *Mathematical and statistics with applications* (7th ed.). Thomson.

SIT2002 FURTHER MATHEMATICAL STATISTICS

The exponential family; sufficient, complete and ancillary statistics; Minimum variance unbiased estimators; Sufficient statistics and best estimators; Bayesian estimation; Delta method for asymptotic approximation; Distributions of special quadratic forms; One and two factors analysis of variance; Linear regression theory and inference of parameters; Correlation analysis in bivariate normal distribution; Sequential probability ratio test.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3, TS2, LL2

References:

1. Hogg, R.V., & Craig, A.T. (2013). *Introduction to mathematical statistics* (7th ed.). New York: Wiley.
2. Hogg, R. V., & Tanis, E. (2010). *Probability and statistical inference* (8th ed.). USA: Pearson Education.
3. Bickel, P.J., & Doksum, K.A. (2001). *Mathematical statistics: Basic ideas and selected topics* (Vol.1) (2nd ed.). Upper Saddle River, NJ: Prentice- Hall.
4. Casella, G., & Berger, R.L. (2002). *Statistical Inference* (2nd ed.). Pacific Grove, CA: Thompson Learning.

SIT2003 STOCHASTIC PROCESSES

Definition and examples of stochastic processes. Introduction to simple random walk. Discrete time Markov Chains. Transition probability. Properties of class. Transience and recurrence properties. Absorbing probability. Stationary distribution and limiting probability. Some applications.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. Lefebvre, M. (2007). *Applied stochastic processes*. Springer.
2. Ross, S. M. (2007). *Introduction to probability models* (9th ed.). Academic Press.
4. Jones, P. W. (2001). *Stochastic processes: An introduction.* Arnold.
5. Durrett, R. (2012). *Essentials of stochastic processes.* Springer.

SIT2004 REGRESSION ANALYSIS

Simple linear regression: Estimation, hypothesis testing, analysis of variance, confidence intervals, correlation, the residuals, prediction. Model inadequacies, diagnostic, heterogeneity of variance, nonlinearity, distributional assumption, outliers, transformation. Selected topics on matrix theory and multivariate normal distribution: An introduction to multiple linear regression.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS2, CTPS3, EM1

References:

1. Weisberg S. (1985). *Applied linear regerssion* (2nd ed.). Wiley.
2. Bowerman B. L., & O'Connel R.T. (1990). *Linear statistical models* (2nd ed.). PWS-Kent.
3. Myers, R.H., & Miltors J.S. (1991). *A first couse in the theory of linear statistical models*. PWS-Kent.
4. Montgomery, D.C., & Peck, E. A. (1992). *Introduction to linear regression analysis.* Wiley.
5. J.S. Milton, & J.C. Arnold (2004). *Introduction to probability and statistics*. McGraw-Hill.

SIT2005 DATA ANALYSIS I

Statistical Analysis for mean, variance, count and proportion: Hypothesis testing, confidence interval and tests of independence.
Statistical analysis for regression and Correlation: continuous response data, simple and multiple linear model.

Statistical tests: Goodness of fit tests, ANOVA, Nonparametric test

Assessment:
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. *Tibco Spotfire S-Plus Guide to Statistics* (Vol. 1). (2008). TIBCO Software Inc.
2. Mann, Prem. S. (2003). *Introductory statistics*. John Wiley & Sons.
3. Siegel, A.W., & Morgan, C.J. (1998). *Statistics and data analysis.* John Wiley & Sons.
4. Evans, J.R., & Olson, D.L. (2002). *Statistics, data analysis and decision modeling* (2nd ed.). Prentice Hall.

SIT2006 NON-PARAMETRIC STATISTICS

Statistical hypotheses, binomial test, runs test, sign test, contingency tables, median test, chi-square Goodness of Fit test, median test, some methods based on ranks.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS2, CTPS2, EM2

References:
1. W. W. Daniel. (1990). *Applied nonparametric statistics* (2nd ed.). PWS-Kent.
2. J. D.Gibbons. (1985). *Nonparametric methods for quantitative analysis.* Columbus: American Science Press.
3. W. J. Conover. (1980). *Practical nonparametric statistics.* Wiley.
4. M. Kraska-Miller. (2014). *Nonparametric statistics for social and behavioral sciences*. CRC Press Taylor & Francis Group.

SIT3001 INTRODUCTION TO PROBABILITY THEORY

An introduction to concepts and fundamentals of measure theory essential for a rigorous approach to the basics of probability.

Sequences and series of functions and sets, convergence, limit infimum and limit supremum.

Rings and algebras of sets, construction of a measure. Measurable functions and their properties, Egorov's theorem, convergence in measure. Lebesgue integral, its elementary properties, integral and sequences, Fubini theorem.

Probability space and measure. Random variables. Independence. Sums of random variables. Borel-Cantelli Lemma. Convergence in distribution, in probability and almost surely; Weak and Strong Laws of Large Numbers, Central Limit Theorem. Law of Iterated Logarithm. Generating functions: characteristic functions, moment generating functions.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:
1. Billingsley, P. (1995). *Probability and measure* (3rd ed.). New York: John Wiley.
2. Durrett, R. (2010). *Probability: Theory and examples* (4th ed.). Cambridge: Cambridge University Press.
3. Rosenthal, J. S. (2006). *A first look at rigorous probability theory* (2nd ed.). Singapore: World Scientific Publishing Company.
4. Wade, W. (2017). *An introduction to analysis*. (4th ed.). England: Pearson.

SIT3002 INTRODUCTION TO MULTIVARIATE ANALYSIS

The use/application of multivariate analysis. Managing and handling multivariate data. Matrix theory. Random vectors and matrices. Multivariate normal distribution. Wishart distribution and Hotellings distribution. Selected topics from graphical methods, regression analysis, correlation, principal components, factor analysis, discriminant analysis and clustering methods.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS2, CTPS3

References:
1. Johnson, K. A., & Wichern, D. W. (2002). *Applied multivariate analysis* (5th ed.). Upper Saddle River, NJ: Prentice-Hall International.
2. Chatfield, C., & Collins, A. J. (1980). *An introduction to multivariate analysis*. Chapman & Hall.
3. Anderson, T. A. (1984), *An introduction to multivariate statistical analysis* (2nd ed.). New York: John Wiley.

SIT3003 COMPUTER INTENSIVE METHODS IN STATISTICS

Computer generation of uniform and non-uniform random variables. Monte Carlo evaluation of integrals. Bootstrap and jackknife methods. Variance reduction techniques. Expectation-Maximization algorithm. Markov Chain Monte Carlo methods.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%
Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:
1. Ross, S. M. (2002). *Simulation* (3rd ed.). Academic Press.
2. Roberts, C.P., & Casella, G. (1999). *Monte Carlo statistical methods.* Springer.
3. Dagpunar, J. S. (2007). *Simulation and Monte Carlo*. Wiley.
4. Gentle, J. E., Härdle, W. K., & Mori, Y. (2012) *Handbook of computational statistics: Concepts and Methods.* Springer.

SIT3004 APPLIED STOCHASTIC PROCESSES

Time reversible Markov chains. Poisson processes. Continuous-time Markov chains and birth and death processes. Brownian motion. Application to real-world phenomena, such as in finance.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. Ross, S. M. (2003). *An introduction to probability models* (8th ed.). Academic press.
2. Kao, E. P. C. (1997.) *An introduction to stochastic processes.* Duxbury Press.
3. Ross, S. M. (1996). *Stochastic processes* (2nd ed.). John Wiley.
4. Durrett, R. (2012). *Essentials of stochastic processes* (2nd ed.). Springer.

SIT3005 TIME SERIES AND FORECASTING METHODS

Introduction to time series: data, properties, examples.

Introduction to forecasting: Forecasting methods, errors in forecasting, choosing a forecasting techniques, qualitative and quantitative forecasting techniques.

Time series regression: Modelling trend, detecting autocorrelation, type of seasonal variation, modelling seasonal variation, growth curve models, handling first-order autocorrelation

Averaging methods: Moving average, Simple exponential smoothing, tracking signals, Holt's method, Holt-Winters Methods, damped trend exponential method.

Box-Jenkins Methods: Stationary data and non-stationary data, difference, autocorrelation function and partial autocorrelation functions, non-seasonal modeling (ARIMA), diagnostic checking, forecasting.
ARCH and GARCH models.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:

1. Hyndman, R.J., & Athanasopoulus, G. (2014). *Forecasting: principles and practice*. Retrieved from https://www.otexts.org/fpp
2. Makridakis, S., Wheelwright, S.C., & Hyndman, R.J. (1998). *Forecasting methods and applications*. Wiley.
3. Montgomery, D. C., Jennings, C. L., & Kulahci, M. (2008). *Introduction to time series analysis and forecasting.* Wiley.
4. Brockwell, P.J., & Davis, R. A. (2002). *Introduction to time series analysis and forecasting* (2nd ed.). Springer.
5. Box, G.E.P., Jenkins, G.W., & Reinsel, G. (1994). *Time series analysis, forecasting and control* (3rd ed.). Prentice Hall.

SIT3006 FURTHER TOPICS IN REGRESSION ANALYSIS

Multiple Linear Regression Model: Simultaneous Inference, criteria for selecting model, influence diagnostics and multi-collinearity. Introduction to logistic regression and Poisson regression: maximum likelihood estimates of the parameters, lack of fit test, tests based on deviance and score.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS2, CTPS2

References:

1. S. Weisberg (2005). *Applied linear regression* (3rd ed.). Wiley.
2. A. Agresti (2013). *Categorical data analysis* (3rd ed.). Wiley.
3. P. McCullagh, & J. A. Nelder. (1989). *Generalized linear models* (2nd ed.). Chapman& Hall.
4. R. H. Myers. (1990). *Classical and modern regression with applications* (2nd ed.). Duxbury/Thompson.
5. R. R. Hocking. (2013). *Method and applications of linear models: Regression and the analysis of variance (3rd ed.)*. Wiley.

SIT3007 DATA ANALYSIS II

Introduction to different kind of data; Generalizing the linear regression models including nonlinear regression model, Linear regression in time series data, logistic regression and Poisson regression models for categorical response data and selected topics

Practical survey sampling: Selected case study, design of study, questionnaires, collecting data, data analysis, oral and written presentation
Statistical consulting: Theoretical and practical aspects of statistical consulting, Communication skill
Report writing

Assessment:
Continuous Assessment: 50%
Final Examination: 50%

Medium of Instruction:
English

Soft Skills:
CS4, CTPS3, TS5

References:

1. *S-Plus 2000 guide to statistics* (Vols. 1-2). Mathsoft corporation.
2. Cramer, D. (2003). *Advanced quantitative data analysis.* Open University Press.
3. Evans, J.R., & Olson, D.L. (2007). *Statistics, data analysis, and decision modeling.* Prentice Hall
4. Miller, D.C., & Salkind, J. (1983). *Handbook of research design and social measurements*. Sage Publication.
5. Derr, J. (2000). *Statistical consulting: A guide to effective communication.* Pacific Grove: Duxbury.
6. Jarman, Kristin H. (2013). *Art of data analysis: How to Answer almost any question using basic statistics*. John Wiley & Sons

SIT3008 INTRODUCTION TO SURVEY SAMPLING

Techniques of statistical sampling with applications in the analysis of sample survey data. Topics include simple random sampling, stratified sampling, systematic sampling, cluster sampling, two-stage sampling and ratio and regression estimates.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:
1. Scheaffer, R. L. (2006), *Elementary survey sampling* (6th ed.). Duxbury.
2. Thompson, S. K. (2002), *Sampling* (2nd ed.). Wiley.
3. Lohr, Sharon L. (2010). *Sampling: Design and analysis* (2nd ed). Cengage Learning.
4. Cochran, W. (1977). *Sampling techniques* (3rd ed.). Wiley.

SIT3009 STATISTICAL PROCESS CONTROL

Methods and philosophy of statistical process control. Control charts for variables and attributes. CUSUM and EWMA charts. Process capability analysis. Multivariate control charts. Acceptance sampling by attributes and variables.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:
1. D. C. Montgomery. (2009). *Introduction to statistical quality control* (6th ed.). Wiley.
2. R. S. Kenett, & S. Zacks. (1998). *Modern industrial statistics: Design and control of quality and reliability*. Duxbury Press.
3. A. J. Duncan. (1986). *Quality control and industrial statistics* (5th ed.). Irwin.

SIT3010 INTRODUCTION TO DATA MINING

Description: Introduction to statistical methods and tools for analysis of very large data sets and discovery of interesting and unexpected relationships in the data.

Data preprocessing and exploration: data quality and data cleaning. Data exploration: summarizing and visualizing data; principal component, multidimensional scaling. Data analysis and uncertainty: handling uncertainty; statistical inference; sampling.

Statistical approach to data mining and data mining algorithms: Regression, Validation; classification and clustering: k-means, CART, decision trees; Artificial Neural Network; boosting; support vector machine; association rules mining. Modelling: descriptive and predictive modelling. Data organization.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:
1. Adriaans, P., & Zantige, D. (1996). *Data mining.* Addison-Wesley.
2. Hand, D., Mannila, H., & Smyth, P. (2001). *Principles of data mining.* MIT Press.
3. Cios. K. J. et al. (2010). *Data mining: A knowledge discovery approach.* New York: Springer-Verlag

SIT3011 BIOINFORMATICS

Statistical modelling of DNA/protein sequences: Assessing statistical significance in BLAST using the Gumbel distribution; DNA substitution models; Poisson and negative binomial models for gene counts; Hidden Markov Model.

Algorithms for sequence analysis and tree construction: Dynamic programming for sequence alignment and Viterbi decoding; neighbour-joining, UPGMA, parsimony and maximum likelihood tree-building methods.

Analysis of high-dimensional microarray / RNA-Seq gene expression data: Statistical tests for detecting differential expression, feature selection, visualization, and phenotype classification.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:
1. Jones, N.C., & Pevzner, P.A. (2004). *An introduction to bioinformatics algorithms.* Massachusetts: MIT Press.
2. Durbin, R., Eddy, S., Krogh, A., & Mitchison, G. (1998). *Biological sequence analysis: Probabilistic models of proteins and nucleic acids*. Cambridge: Cambridge University Press.
3. Ewens, W.J., & Grant, G.R. (2005). *Statistical methods in bioinformatics: An introduction* (2nd ed.). New York: Springer.
4. Pevsner, J. (2009). *Bioinformatics and functional genomics* (2nd ed.). New York: Wiley-Blackwell.

SIT3012 DESIGN AND ANALYSIS OF EXPERIMENTS

Philosophy related to statistical designed experiments. Analysis of variance. Experiments with Blocking factors. Factorial experiments. Two level factorial designs. Blocking and confounding system for two-level factorials. Two-level fractional factorial designs.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS4

References:
1. Montgomery, D.C. (2004). *Design and analysis of experiments* (6th ed.). John Wiley.
2. Box, G. E. P., Hunter, W. G., & Hunter, J. S. (2005). *Statistics for experimenters* (2nd ed.). John Wiley.
3. Tabachnick, B. G., & Fidell, L. S. (2007). *Experimental designs using ANOVA.* Duxbury.
4. Myers, R.H. (1990). *Classical and modern regression analysis with applications* (2nd ed.). Duxbury.

SIT3013 ANALYSIS OF FAILURE AND SURVIVAL DATA

Survival distributions, hazard models. Reliability of systems, stochastic models. Censoring and life-tables. The product-limit estimator. Parametric survival models under censoring. Cox proportional hazards model and other basic models with covariates.

Assessment:
Continuous Assessment: 40%
Final Examination: 60%

Medium of Instruction:
English

Soft Skills:
CS1, CTPS2

References:
1. Sherwin D.J., & Bossche A. (2012), *The reliability, availability and productiveness of systems.* Netherlands: Springer.
2. Peter J. Smith. (2002). *Analysis of failure and survival data.* Chapman & Hall.
3. Tableman M., & Kim J.S. (2004). *Survival analysis using S: Analysis of time-to-event data.* Chapman & Hall.
4. Smith D.J. (2011). *Reliability maintainability and risk: Practical methods for engineers* (8th ed.). Elsevier Ltd.

SIT3014 INTRODUCTION TO BAYESIAN STATISTICS

Bayes' Theorem. Bayesian framework and terminology. Bayesian inference. Prior formulation. Implementation via posterior sampling. Bayesian decision theory. Application to real-world problems.

Assessment:
Continuous Assessment: 40%
Final Examination : 60%

Medium of Instruction:
English

Soft Skills:
CS3, CTPS3

References:
1. Lee, P. M. (1991). *Bayesian statistics: an introduction*. Oxford University Press.
2. Hoff, P. D. (2009). *A first course in Bayesian statistical methods.* Springer.
3. Koch, K. (2007). *Introduction to Bayesian statistics* (2nd ed.). Springer.
4. Cowles, M. K. (2013). *Applied Bayesian statistics: With R and OpenBUGS examples.* Springer.