Master of Science
Statistics & Mathematics

Academic Session 2022/2023

School of Mathematical Sciences

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ACADEMIC CALENDAR
ACADEMIC SESSION 2022/2023
UNIVERSITI SAINS MALAYSIA

ACADEMIC CALENDAR - ACADEMIC SESSION 2022/2023
FOR ALL SCHOOLS (EXCEPT FOR SCHOOL OF MEDICAL SCIENCES AND SCHOOL OF DENTAL SCIENCES)

Main Campus : Registration for New Student (07 - 09 October 2022) / **Orientation Week (10 - 14 October 2022)
Engineering Campus : Registration for New Student (08 October 2022) / **Orientation Week (08 - 14 October 2022)
Health Campus : Registration for New Student (09 October 2022) /Orientation Week (09 - 13 October 2022)**

SEM	WEEK	ACTIVITY		DATE	REMARKS
ONE	1			Monday, 17.10.2022 - Sunday, 23.10.2022	
	2			Monday, 24.10.2022 - Sunday, 30.10.2022	24.10.2022, Monday - Deepavali**
	3			Monday, 31.10.2022 - Sunday, 06.11.2022	
	4	Teaching & Learning (T&L 7 Weeks)		Monday, 07.11.2022 - Sunday, 13.11.2022	11, 12 & 13.11.2022, Friday, Saturday & Sunday - Sultan of Kelantan's Birthday (Kelantan)
	5			Monday, 14.11.2022 - Sunday, 20.11.2022	
	6			Monday, 21.11.2022 - Sunday, 27.11.2022	
	7			Monday, 28.11.2022 - Sunday, 04.12.2022	
	8	Mid Semester Break (1 Week)		Monday, 05.12.2022 - Sunday, 11.12.2022	
	9			Monday, 12.11.2022 - Sunday, 18.12.2022	
	10			Monday, 19.12.2022 - Sunday, 25.12.2022	25.12.2022, Sunday - Christmas
	11	Teaching & Learning (T&L 7 Weeks)		Monday, 26.12.2022 - Sunday, 01.01.2023	26.12.2022, Monday - Christmas 01 & 02.01.2023, Sunday & Monday - New Year of 2023
	12			Monday, 02.01.2023 - Sunday, 08.01.2023	
	13			Monday, 09.01.2023 - Sunday, 15.01.2023	
	14			Monday, 16.01.2023 - Sunday, 22.01.2023	22.01.2023, Sunday - Chinese New Year
	15			Monday, 23.01.2023 - Sunday, 29.01.2023	23 & 24.01.2023, Monday & Tuesday - Chinese New Year
	16	Revision Week (1 Week)		Monday, 30.01.2023 - Sunday, 05.02.2023	04.02.2023, Saturday - Thaipusam**
	17	Examination (3 Weeks)		Monday, 06.02.2023 - Sunday, 12.02.2023	
	18			Monday, 13.02.2023 - Sunday, 19.02.2023	
	19			Monday, 20.02.2023 - Sunday, 26.02.2023	
	20	Mid Semester Break / Industrial Training (4 Weeks)		Monday, 27.02.2023 - Sunday, 05.03.2023	
	21			Monday, 06.03.2023 - Sunday, 12.03.2023	
	22			Monday, 13.03.2023 - Sunday, 19.03.2023	
	23			Monday, 20.03.2023 - Sunday, 26.03.2023	23.03.2023, Thursday - Ramadhan
TWO	24/1			Monday, 27.03.2023 - Sunday, 02.04.2023	
	25/2	Teaching & Learning (T&L 7 Weeks)		Monday, 03.04.2023 - Sunday, 09.04.2023	06.04.2023, Saturday - Nuzul Al-Quran
	26/3			Monday, 10.04.2023 - Sunday, 16.04.2023	
	27/4			Monday, 17.04.2023 - Sunday, 23.04.2023	22 & 23.04.2023, Saturday & Sunday - Eid-ul fitr**
	28/5			Monday, 24.04.2023 - Sunday, 30.04.2023	24.04.2023, Monday - Eid-ul fitr**
	29/6			Monday, 01.05.2023 - Sunday, 07.05.2023	01.05.2023, Monday - Labour Day 04.05.2023, Thursday - Wesak Day
	30/7			Monday, 08.05.2023 - Sunday, 14.05.2023	
	31/8	Mid Semester Break (1 Week)		Monday, 15.05.2023 - Sunday, 21.05.2023	
	32/9			Monday, 22.05.2023 - Sunday, 28.05.2023	
	33/10			Monday, 29.05.2023 - Sunday, 04.06.2023	30 & 31.05.2023, Tuesday & Wednesday - Pesta Kaamatan (Sabah) 01 & 02.06.2023, Wednesday & Thursday - Hari Gawai (Sarawak)
	34/11	Teaching & Learning (T&L 7 Weeks)		Monday, 05.06.2023 - Sunday, 11.06.2023	05.06.2023, Monday - Agong's Birthday
	35/12			Monday, 12.06.2023 - Sunday, 18.06.2023	
	36/13			Monday, 19.06.2023 - Sunday, 25.06.2023	
	37/14			Monday, 26.06.2023 - Sunday, 02.07.2023	28 & 29.06.2023, Wednesday & Thursday - Eid-ul adha**
	38/15			Monday, 03.07.2023 - Sunday, 09.07.2023	07.07.2023, Friday - Penang Heritage 08.07.2023, Saturday - Penang Governer's Birthday
	39/16	Revision Week (1 Week)		Monday, 10.07.2023 - Sunday, 16.07.2023	
	40/17	***Examination (2 Weeks)	Examination (3 Weeks)	Monday, 17.07.2023 - Sunday, 23.07.2023	19.07.2023, Wednesday - Awal Muharram
	41/18			Monday, 24.07.2023 - Sunday, 30.07.2023	
	42/19			Monday, 31.07.2023 - Sunday, 06.08.2023	
*KSCP / LONG SEMESTER BREAK	43/20	Long Semester Break / Industrial Training (10/11 Weeks)		Monday, 07.08.2023 - Sunday, 13.08.2023	
	44/21			Monday, 14.08.2023 - Sunday, 20.08.2023	
	45/22			Monday, 21.08.2023 - Sunday, 27.08.2023	
	46/23			Monday, 28.08.2023 - Sunday, 03.09.2023	31.08.2023, Wednesday - National Day
	47/24		*T&L	Monday, 04.09.2023 - Sunday, 10.09.2023	
	48/25			Monday, 11.09.2023 - Sunday, 17.09.2023	16.09.2023, Friday - Malaysia Day
	49/26		Examination	Monday, 18.09.2023 - Sunday, 24.09.2023	
	50/27			Monday, 25.09.2023 - Sunday, 01.10.2023	27.09.2023, Wednesday - Prophet Muhammad's Birthday
	51/28			Monday, 02.10.2023 - Sunday, 08.10.2023	
	52/29			Monday, 09.10.2023 - Sunday, 15.10.2023	

**This Academic Calendar is subject to change

IMPORTANT DATES FOR FULL-TIME CANDIDATES
DISSERTATION COURSES MAT 510/20 AND MST 566/20

ACADEMIC SESSION 2022/2023

Candidates submit the Confirmation Form
signed by the supervisor to the General Office,
School of Mathematical Sciences
by **7th January 2023**

↓

Candidates register for MAT510/MST566
in Semester Two
Academic Session **2022/2023**
**** Candidates are required to have accumulated 12 units***

↓

An interim seminar will be held
around the 4th week of Semester Two,
Academic Session **2022/2023**

↓

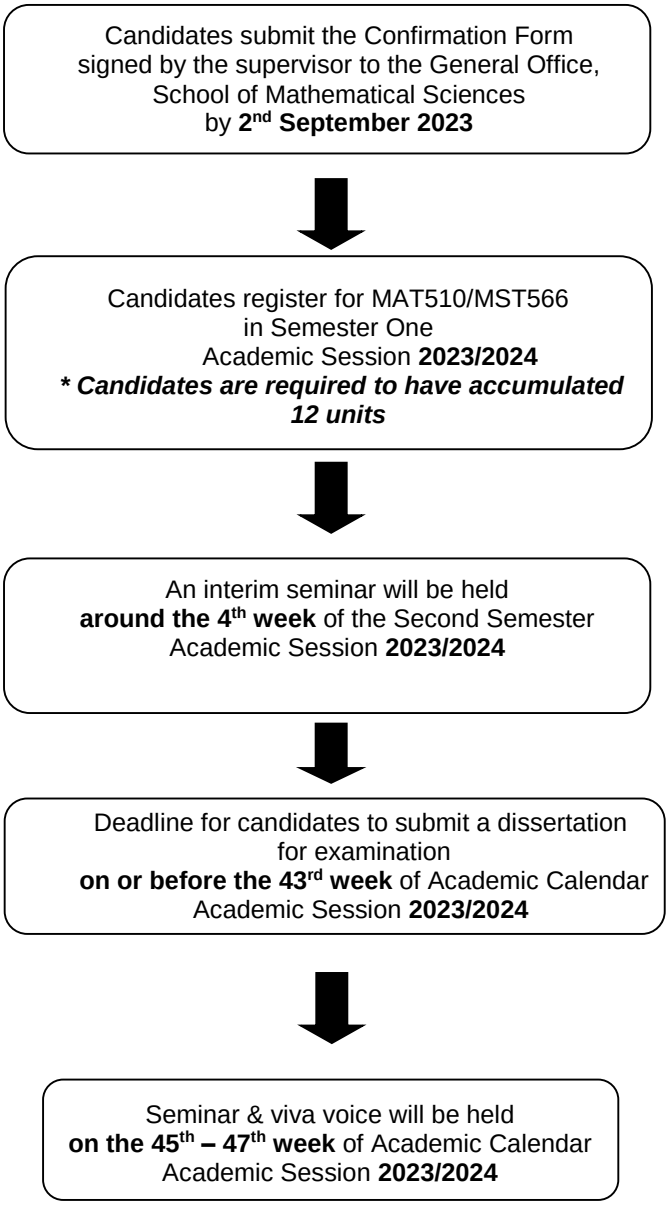
Deadline for candidates to submit a dissertation
for examination
on or before the 43rd week of Academic Calendar
Academic Session **2022/2023**

↓

Seminar & viva voce will be held
on the **45th – 47th week** of the Academic Calendar
Academic Session **2022/2023**

IMPORTANT DATES FOR PART-TIME CANDIDATES
DISSERTATION COURSES MAT 510/20 AND MST 566/20
(for 2022/2023 intake)

ACADEMIC SESSION 2022/2023



Submission date of supervisor confirmation form for part-time students Academic Session **2022/2023** is by **2nd September 2023**.

MASTER OF SCIENCE (STATISTICS)

A. OBJECTIVE

The objective of the program is to produce experts in the field of statistics who are able to undertake research and development activities in addition to the teaching of statistics at the postgraduate level.

B. PROGRAM STRUCTURE

Mixed Mode student must comply with the following program structure and graduation requirements:

- Pass all courses, dissertation/research project and obtain at least a C+ grade; and
- Achieve at least a CGPA of 3.00; and
- Fulfill the minimum duration of candidature; and
- The Bahasa Malaysia 1 (LKM 100) is compulsory for all international students. Minimum grade C must be obtained prior to graduation.

C. COURSES

MST561/4	:	Statistical Inference *(Pentaabiran Statistik)*
MST562/4	:	Stochastic Processes *(Proses Stokastik)*
MST564/4	:	Statistical Reliability *(Kebolehpercayaan Statistik)*
MST565/4	:	Linear Models *(Model Linear)*
MST566/20	:	Dissertation *(Disertasi)*
MST567/4	:	Categorical Data Analysis *(Analisis Data Berkategori)*

For full time students, the minimum period given to complete the program is 12 months with a maximum period of 24 months. For part time students, the minimum period is 24 months and a maximum of 48 months.

Full time students have to register MST561/4, MST562/4, MST564/4 and MST567/4 in the first semester, and MST565/4 and MST566/20 in the second semester. Part time students are encouraged to seek the advice of the Deputy Dean (Research, Innovation and Industry-Community Engagement) concerning course registration.

SYNOPSIS OF STATISTICS COURSES

1.0 MST561/4 Statistical Inference *(Pentaabiran Statistik)*

Aim

To introduce the students to basic statistical theory at an advanced level.

Description

This course will cover basic statistical theory at an advanced level. Point estimation theory, interval estimation theory, Bayesian procedures and hypothesis testing theory will be done at a theoretical level.

Syllabus

Revision of Probability Theory is required. Change of Variables. Order Statistics. Limiting Distributions. Limit Theorems. Sample Moments and Their Distributions. Distributions of Functions of Random Variables.

Estimation theory: Point Estimation: Sufficiency, completeness, consistency, unbiasedness, efficiency. Neyman-Fisher Factorization Criterium, Rao-Blackwell's Theorem, Lehmann-Scheffe's Theorem. Uniform Minimum Variance Unbiased Estimation. Cramer-Rao Inequality. Method of moments. Method of Maximum Likelihood. Bayes Estimation. Quasi Maximum Likelihood Estimation.

Interval Estimation: Confidence Intervals for Small and Large Samples. Methods of Constructing Confidence Interval.

Hypothesis Testing: Type I & Type II errors, non-randomized test, randomized test critical region, critical function, power of a test**,** power function, Most Powerful Test, Uniformly Most Powerful Test, Unbiased Test, Invariant Test, Likelihood Ratio Test. Generalized Likelihood Ratio Test.

Skills and Knowledge Acquired

At the end of the course the students will have a better appreciation of statistical theory. They will see that many of the statistical procedures that are taught at an elementary level are actually optimal.

References

1. Rohatgi, V. K. Md. Ehsanes Saleh, A. K. (2015). *An Introduction to Probability and Statistics (Wiley Series in Probability and Statistics) 3rd Edition*. John Wiley, New Jersey.
2. Hogg. R. V., McKean, J. W. & Craig. A. T. (2005). *Introduction to Mathematical Statistics, 6th edition*. New York, Pearson Prentice Hall.
3. Larsen, R. J. & Marx, M. L. (2006). *Introduction to Mathematical Statistics and Its Applications, 4th edition*. New York, Pearson Prentice Hall.
4. Miller, I. & Miller, M. (2004). *Mathematical Statistics with Application, 7th edition*. New Jersey: Pearson Prentice Hall

2.0 MST562/4 Stochastic Processes *(Proses Stokastik)*

Aim

To introduce the students to basic stochastic processes.

Description

This course will cover stochastic processes. Students will be exposed to Markov processes and its applications. Poisson processes, branching processes, birth and death processes will be discussed. Applications to Queuing Theory will be given.

Syllabus

Conditional Probability. Conditional Expectation.

Convergence in Distribution. Convergence in Probability. Convergence with Probability One.

Limiting Distributions.

Stochastic Processes: Random Walks. Discrete Time Markov Chains. Continuous Time Markov Chains. Classification of States. Equilibrium and Limiting Behavior.Recurrence Times.

Discrete Time Markov Processes. Continuous Time Markov Processes.

Poisson Processes. Counting Processes. Branching Processes. Birth and Death Processes.

Queuing Models. Brownian Processes. Stationary Processes.

Simulation.

Skills and Knowledge Acquired

At the end of the course, the students will have a better appreciation of stochastic processes. They will be able to identify many of the phenomena that occur as random processes and apply the tools taught to these problems.

References

1. Ross, S. M. (2014). *Introduction to Probability Models, 11th Edition*. Academic Press.
2. Ross, S. M. (1996). *Stochastic Processes, 2nd Edition*. Wiley.
3. Karlin, S. & Taylor, H. M. (1975). *A First Course in Stochastic Processes, 2nd Edition*. Academic Press.
4. Pinsky, M. A. & Karlin, S. (2011). *An Introduction to Stochastic Modeling, 4th Edition*. Academic Press.

3.0 MST564/4 Statistical Reliability *(Kebolehpercayaan Statistik)*

Aim

To introduce the models and statistical methods for survival data analysis, both in biomedical and reliability research.

Description

This course introduces the basic and most commonly used statistical methods of analyzing lifetime data. Both parametric and nonparametric models and procedures are included with applications in various fields, especially in the biomedical sciences and reliability engineering. This course also considers system lifetimes and system structure.

Syllabus

Introduction to reliability/survival concepts, examples of reliability data and the different types of censoring.

Lifetime Distribution: survivor/reliability function, hazard function and cumulative hazard function, mean lifetime and residual lifetime (MTTF/MTBF), distribution classes (IFR and DFR), likelihood function construction under different types of censoring.

Parametric Lifetime Models: exponential distribution, Weibull distribution, lognormal distribution, extreme value distribution and other distributions such as the gamma, logistic and the Log-Logistic distribution.

Estimation of survival function and other related functions, estimation from censored data (Kaplan-Meier) and the confidence interval, tests on survival function.

Probability plotting: linearizing the exponential, Weibull and other distributions, graphical goodness-of-fit.

Parametric Estimation of Models: for complete and censored data; exponential, Weibull and other models, planning life tests, estimation and test procedures under different types of censoring.

Regression Models: accelerated lifetime model and the proportional hazards model.

System Reliability: structure functions, block diagram, minimal path and cut sets, reliability functions.

Repairable Systems: point processes and availability.

Industrial visit or industrial talk will be one of the components in this course focusing on the application of statistical reliability in industry and real-life situation.

Skills and Knowledge Acquired

The students should be able to handle the appropriate method to analyze survival data using statistical packages.

References

1. Lawless, J. F. (2003). *Statistical Models and Methods for Lifetime Data. 2nd Edition*. Hoboken, New Jersey: John Wiley & Sons, Inc.
2. Bain, L. J. (1991). *Statistical Analysis of Reliability and Life-testing Model: Theory and Methods. 2nd Edition*. New York: Marcel Dekker Inc.
3. Bunday, B. D. (1991). *Statistical Methods in Reliability Theory and Practice*. New York: Ellis Horwood.
4. Leemis, L. M. (1995). *Reliability: Probabilistic Models and Statistical Methods*. New Jersey: Prentice – Hall.
5. Lee, E.T. & Wang, J. W. (2003). *Statistical Methods for Survival Data Analysis. 3rd Edition. Hoboken: John Wiley & Sons Inc.*
6. Meeker, W. Q. & Escobar, L. A. (1998). *Statistical Methods for Reliability Data*. New York: John Wiley.

4.0 MST565/4 Linear Models *(Model Linear)*

Aim

To introduce the basic theory of Linear Models with applications to analysis of variance models and linear regression analysis.

Description

Basic theory of Linear Models will be developed. Applications to ANOVA and Regression models will be discussed. This course will cover various types of Linear Models along with corresponding estimation procedures and testing of hypotheses. Statistical software packages will be used in this course.

Syllabus

Introduction to Linear Models: Simple Linear Regression Model, Multiple Linear Regression Model, Analysis of Variance Models.

Revision of Matrix Algebra Concepts: Matrix Operations, Transpose, Inverse, Orthogonality, Rank, Eigenvalues and Eigenvectors, Idempotent Matrices, Trace.

Quadratic Forms and Their Distributions: Sums of Squares, Mean and Variance of Quadratic Forms, Distribution of Quadratic Forms, Independence of Linear Forms and Quadratic Forms

Simple Linear Regression: The Model, Estimation of Parameters, Hypothesis Test and Confidence Interval for Parameters, Coefficient of Determination.

Multiple Regression: The Model, Estimation of Parameter and Variance, Properties of Least Squares Estimators, Maximum Likelihood Estimation, Coefficient of Multiple Determination.

Tests of Hypotheses for Multiple Regression Parameters: Test of Overall Regression, Test on a Subset of Parameters, The General Linear Hypothesis Tests, Testing One or Several Parameters, Confidence Intervals and Prediction Intervals, Likelihood Ratio Tests, Generalized Least Squares.
Model Validation and Diagnostics: Residuals, The Hat Matrix, Outliers, Influential Observations and Leverages.

Analysis of Variance Models: Non-full Rank Models, Estimation, Testing of Hypotheses.

One-Way Analysis of Variance: The Model, Estimable Functions, Estimation of Parameters, Testing of Hypotheses.

Two-Way Analysis of Variance: The Model, Estimable Functions, Estimation, Tests of Hypotheses.

Skills and Knowledge Acquired

At the end of the course, the students will be able to use the knowledge acquired to solve statistical problems related to a wide range of linear models in various fields of applications.

Recommended Text: Rencher, A.C. (2008). *Linear Models in Statistics. 2nd Edition,* New York: Wiley

References

1. Rencher, A. C. (2000). *Linear Models in Statistics.* John Wiley & Sons, Inc, Canada.
2. Littell, R. C. Stroup, W. W. & Freund, R. J. (2002). *SAS for Linear Models, 4th Edition*. John Wiley & Sons, Inc. Canada.
3. Faraway. J. J. (2014). *Linear Models with R*, New York: Taylor & Francis Ltd.

5.0 MST566/20 Dissertation *(Disertasi)*

Students are required to submit the **Dissertation Supervisor Confirmation Form (APPENDIX A)** no later than **week 15 of the first semester of the academic session (January).** For all students, a minimum of 12 units has to be accumulated before they are allowed to register for this course in the month of **April** (during the second semester registration). There will be an interim viva/presentation around the **4th week of the second semester** consisting of the background study, objectives and methodology to determine the direction of the research.

Full time and part time students are required to submit their dissertation (after confirmation by their respective supervisors) no later than **a date that will be determined**. Please note that starting from 2019/2020 academic session, students are required to submit a research paper from a compilation of their dissertation to be appended in their dissertation report. The template for the research paper will be provided via the school's website. The submitted dissertation will be assessed by a committee of examiners and, within 1 – 2 weeks after this date, there will be a seminar presentation (30 mins) and finally the viva. The viva will begin with a short oral presentation by the student regarding his/her achievements followed by a question-and-answer session.

Details are available in the **GUIDELINES FOR PREPARATION OF DISSERTATION or via** https://math.usm.my.

The above-mentioned dates are subjected to change and further information on this matter will be displayed on the School of Mathematical Sciences notice board from time to time.

6.0 MST567/4 Categorical Data Analysis (*Analisis Data Berkategori*)

Aim

To expose students the proper method of analyzing categorical data, interpreting parameters in the model and checking adequacy of models using statistical packages such as SPSS and SAS.

Description

Introduction to the analysis of discrete data, fitting log-linear models; linear logistic regression models; goodness of fit tests; residual analysis; applications with the use of statistical packages.

Syllabus

Introduction to the analysis of frequency data. General goodness -of-fit test: Pearson chi-square test and likelihood ratio test. Test of fit. Estimation and inference on two-way contingency tables. Test of independence. Exact inference for the odds ratio in 2x2 tables.

Three-way contingency tables, marginal and conditional independence; Simpson's paradox; Common odds ratio estimate in stratified 2x2 tables; Measures of association in IxJ tables. Log-linear model: representation, interpretation. Fitting log-linear model: likelihood method; test of goodness of fit. Model building strategies, models for ordinal data, test of conditional independence based on models.

Introduction to Generalized Linear Models. Concepts, Models, Link Functions, Likelihood Function, Estimation, Goodness of Fit Tests.

Logistic regression model for binary outcome: model interpretation; parameter estimation and inference. Goodness of fit and residual analysis. Logistic regression for case-control design; matched case-control design and conditional logistic regression.

Log-linear Model- Representation, Interpretation, Log-linear Models for Two-Way Tables and Three-Way Tables, Fitting Log-Linear Model: Likelihood Method, Test of Goodness of Fit, Model Building Strategies.

Skills and Knowledge Acquired

After following the course, students should be able to handle the appropriate method to analyze categorical data and to interpret the results.

References

1. Agresti, A. (2013). *Categorical Data Analysis, 3rd Edition*, New York: J. Wiley & Sons.
2. Aizen, R. & Walker, C.M. (2010). *Categorical Data Analysis for the Behavioral and Social Sciences,* Routledge.
3. Bishop, Y. M. M, Fienberg, S. E, & Holland, P. W. (2007). *Discrete Multivariate Analysis: Theory and Practice,* Cambridge: MIT Press.
4. Stokes, M. E., Davis, C.S. & Koch, G. G. (2013). *Categorial Data Analysis Using SAS 3rd Edition*. SAS Institute
5. Hosmer, D. W. & Lemeshow, S. (2013). *Applied Logistic Regression 3rd Edition,* New York: J. Wiley & Sons.

LIST OF DISSERTATION SUPERVISORS (MST566/20)

For information about academics' expertise, visit the School of Mathematical Sciences website.

https://math.usm.my/staff/academic-staff

MASTER IN MATHEMATICS

A. OBJECTIVE

The objective of the program is to produce experts in the field of Computational and Applied Mathematics who are able to undertake research and development activities in addition to the teaching of Computational and Applied Mathematics at the postgraduate level.

B. PROGRAM STRUCTURE

Mixed Mode students must comply with the following program structure and graduation requirements:

- Pass all courses, dissertation/research projects and obtain at least a C+ grade; and
- Achieve at least a CGPA of 3.00; and
- Fulfill the minimum duration of candidature; and
- The Bahasa Malaysia 1 (LKM 100) is compulsory for all international students. A minimum grade of C must be obtained prior to graduation.

C. COURSES

MAT510/20	:	Dissertation *(Disertasi)*
MAT514/4	:	Mathematical Modelling *(Pemodelan Matematik)*
MAT515/4	:	Computational Mathematics *(Matematik Pengiraan)*
MAT516/4	:	Curve and Surface for CAGD *(Kaedah Lengkung dan Permukaan untuk RGBK)*
MAT517/4	:	Computational Linear Algebra *(Aljabar Linear Pengkomputeran)*
MAT518/4	:	Numerical Solution of Differential Equations *(Penyelesaian Berangka Persamaan Pembezaan)*

For full-time students, the minimum period given to complete the program is 12 months with a maximum period of 24 months. For part time students the minimum period is 24 months and a maximum of 48 months.

Full-time students have to register MAT514/4, MAT515/4, MAT517/4, and MAT518/4 in the first semester, and MAT516/4 and MAT510/20 in the second semester.Part-time students are encouraged to seek the advice of the Deputy Dean (Research, Innovation & Industry-Community Engagements) concerning course registration.

SYNOPSIS OF MATHEMATICS COURSES

1.0 MAT510/20 Dissertation *(Disertasi)*

All students are required to submit the **Dissertation Supervisor Confirmation Form (APPENDIX A)** no later than **week 15 of the first semester of the academic session (January).** For all students, a minimum of 12 units has to be accumulated before they are allowed to register for this course in the month of **April** (during the second-semester registration). There will be an interim viva/presentation around the **4th week of the second semester** consisting of the background study, objectives, and methodology to determine the direction of the research.

Full-time and part-time students are required to submit their dissertations (after confirmation by their respective supervisors) no later than **a date that will be determined**. Please note that starting from the 2019/2020 academic session, students are required to submit a research paper from a compilation of their dissertation to be appended to their dissertation report. The template for the research paper will be provided via the school's website. The submitted dissertation will be assessed by a committee of examiners and, within 1 – 2 weeks after this date, there will be a seminar presentation (30 mins) and finally the viva. The viva will begin with a short oral presentation by the student regarding his/her achievements followed by a question-and-answer session.

Details are available in the **GUIDELINES FOR PREPARATION OF DISSERTATION or via** https://math.usm.my.

The above-mentioned dates are subjected to change and further information on this matter will be displayed on the School of Mathematical Sciences notice board from time to time.

2.0 MAT514/4 Mathematical Modelling (*Pemodelan Matematik*)

Aim

To equip students with the techniques and skills for developing and interpreting mathematical models.

Description

This course will concentrate on development and interpretation of mathematical models in the physical and life sciences.

Syllabus

This course will concentrate on some of the following topics:

1. Mathematical Modelling with ordinary differential equations.
2. Ecological models.
3. Fluid flow and water resources modelling.
4. Environmental modelling.
5. Convective heat and mass transfer.

The topics may also be adjusted from time to time by the lecturer.

Skills and Knowledge Acquired

At the end of the course, students will have acquired the skills for developing and interpreting mathematical models.

References

1. Strogatz, S. H. (2018). *Nonlinear Dynamics and Chaos with Student Solutions Manual: With Applications to Physics, Biology, Chemistry, and Engineering*. CRC Press
2. Allen, L. J. (2010). *An Introduction to Stochastic Processes with Applications to Biology*. CRC Press
3. Kot, M. (2001). *Elements of Mathematical Ecology*. Cambridge University Press
4. Giordano F. R., Fox W. P. & Horton S. B. (2014). *Convective Heat and Mass Transfer*, *4th Edition*, McGraw Hill
5. Bejan, A. (2013). *Convection Heat Transfer, 4th Edition*, John Wiley & Sons
6. Burmeister, L. C. (1993). *Convective Heat Transfer, 2th Edition*, John Wiley & Sons.

3.0 MAT515/4 Computational Mathematics *(Matematik Pengiraan)*

Aim

To introduce the student to the use of mathematical software *(Mathematica)* as an investigative tool in the field of scientific computing, with special emphasis being put on experimental techniques involving graphical and numerical displays.

Description

The course is split into two distinct but related parts: the lectures on numerical analysis topics and the practical laboratory sessions. The scientific computing topics listed below are intended to introduce the student to important areas of the subject.

The laboratory sessions have the important function of allowing the student to experiment with and investigate mathematical problems. Some of the laboratory time is taken up with the investigation of techniques and problems arising from the lectures. Emphasis will be on built in functions of the software, together with their strengths and weaknesses.

Syllabus

Introduction to Mathematica

1. *Mathematica* syntax
2. List, vectors and matrices
3. Procedural programming
4. Functional programming
5. Rule-based programming
6. Recursion
7. Visualization and graphics

Numerical Analysis Topics

1. Basic concepts
2. System of linear and nonlinear equations
3. Polynomial's approximation
4. Numerical Integration and differentiation
5. IVP and BVP for ordinary differential equations
6. Fast Fourier transform
7. Random numbers and stochastic simulation
8. Advanced topics

Skills and Knowledge Acquired

To be able to use mathematical software, not just for mathematics, but as a general investigative tool in many areas of applicable mathematics, such as that found in industries.

References

1. Mangano, S. (2010), *Mathematica Cookbook*, O' Reilly Media, Inc.
2. Wellin, P., Kamin, S. & Gaylord, R. (2005), *An Introduction to Programming with Mathematica*, Cambridge: University Press.
3. Wagon, S. (2010), *Mathematica in Action*, *3rd Edition*, Springer.
4. Heath, M. T. (2002), *Scientific Computing: An Introductory Survey, 2nd Edition.* McGraw-Hill.
5. Press, W. H., Teukolsky, S. A., Vetterling, W. T. & Flannery, B. P. (2007), *Numerical Recipes, 3rd Edition.* Cambridge University Press.
6. Walter, G. & Jiri, H. (2004), *Solving Problems in Scientific Computing using Maple and MATLAB, 4th Edition.* Springer-Verlag.
7. Chapman, S. J. (2008), *MATLAB Programming for Engineers, 4th Edition*. Thomson Learning.
8. Moler, C. B. (2004), *Numerical Computing with MATLAB*, SIAM.

4.0 MAT516/4 Curve and Surface Methods for CAGD *(Kaedah Lengkung dan Permukaan untuk RGBK)*

Aim

To provide the basic theoretical concepts underlying curve and surface design in CAGD.

Description

This course introduces theory and methods for the approximation and representation of curves and surfaces that arise when these objects are processed by a computer.

Syllabus

Basic concepts of vector geometry and differential geometry. Polynomial interpolation including Lagrange form, Newtons form, Aitken's algorithm and Hermite form.

Concepts of Bezier curves with Bernstein polynomials basis. Curves evaluation with de Casteljau algorithm. Derivatives of Bezier curves, degree elevation and reduction.

Continuity issues of composite curves focused on parametric and geometric continuity. Different representation of spline curves and surfaces such as piecewise Bezier form, piecewise Hermite form and B-Spline.

B-Spline evaluation using subdivision method and de Boor Cox algorithm. Rational Bezier and B-Spline curves and surfaces. Representation of conic segments by rational curves.

Coons patches and Triangular Bezier patches. Shape preserving splines, focusing on positivity (or non-positivity) and monotonocity.

Skills and Knowledge Acquired

At the end of the course, students would have acquired the fundamental theory and knowledge of methods for the design of curves and surfaces.

References

1. Marsh, D. (2005). *Applied Geometry for Computer Graphics and CAD, 2nd Edition*. London: Springer-Verlag
2. Farin, G. (2002). *Curves and Surfaces for CAGD*,*5th Edition*. Elsevier Inc.

5.0 MAT517/4 Computational Linear Algebra *(Aljabar Linear Pengkomputeran)*

Aim

The course deals with computational methods in solving linear algebra problems. In particular, it evolves around the following aspects :

i) the fundamental & numerical properties;
ii) algorithm development;
iii) factorization techniques;
iv) conditioning and stability.

Description

The course is divided into four parts to reflect different aspects of the course :

PART 1 (PRELIMINARIES)

- Numerical Computations, Floating Point Operations, Round-off error, absolute error, relative error;
- Some MATLAB examples;
- Revision of important linear algebra concepts;
- Algorithm, efficiency, stability, conditioning;
- Perturbation analysis of the linear system problem.

PART II (FACTORIZATION METHODS)

- Gaussian elimination, the algorithm, pivoting strategies;
- Gaussian elimination & matrix factorization, elementary matrices, LU Factorization, $\mathbf{LDL}^T$ and Cholesky Factorization ($\mathbf{LL}^T$);
- Orthogonal Factorization Methods: Gram-Schmidt orthogonalization and QR factorization, modified Gram-Schmidt;

- Orthogonal matrices: Orthogonal transformations, Householder matrix, Givens matrices;
- QR factorization using Householder & Givens matrices;
- Solution of linear system of equation using QR factorization;
- Eigenvalue Decomposition, Singular Value Decomposition (SVD), Golub-Kahan-Reinsch algorithm.

PART III (THE LEAST SQUARES PROBLEM)

- Orthogonal projection and best approximation, the normal equation, pseudoinverse;
- Computational Issues in solving the normal equation;
- QR Method for Computing Full Rank, Overdetermined Least Squares Solution;
- Computation of Rank Deficient, Overdetermined Least Squares Solution using SVD.

PART IV (EIGENVALUE PROBLEM)

- Computational difficulties in computing eigenvalues;
- Important definitions & theories: Similarity transformation, eigen decomposition, the Bauer-Fike theorem, Gershgorin Circle;
- Power Iteration;
- Power Method: Basic algorithm, rate of convergence and acceleration, Power method with shift;
- Deflation;
- QR Method for Symmetric Eigenvalue Problem: Special properties of the symmetric eigenvalue problem, basic QR iteration for symmetric matrices, QR algorithm using Givens matrices;
- Accelerating convergence: QR method with shift.

Skills and Knowledge Acquired

At the end of the course, students would have acquired the fundamental theory and knowledge of advanced techniques in Computational Linear Algebra.

References

1. Datta, B. S. (2010), *Numerical Linear Algebra and Applications*, *2nd Edition*. SIAM.
2. Trefethen, L. N. & Bau, D. (1997). *Numerical Linear Algebra*, SIAM.
3. Leon, S. J. (2005). *Linear Algebra with Applications*, Prentice Hall.
4. Golub. G. H. & Charles F. V. L. (2013), *Matrix Computations*, Johns Hopkins University Press.
5. Strang, G. (2019), Linear Algebra and Learning from Data, Wellesley-Cambridge Press.
6. Anton, H. (2013), Elementary Linear Algebra with Applications, John Wiley.

6.0 MAT518/4 Numerical Solution of Differential Equations *(Penyelesaian Berangka Persamaan Pembezaan*)

Aim

To increase students' knowledge of numerical methods for the solution of differential equations.

Description

Differential equations form the basis for the mathematical modeling of various phenomena. This course will focus on the theory and implementation of numerical methods for the solution of differential equations (in particular partial differential equations).

Syllabus

Numerical methods for ordinary differential equations

- Initial value problems: one step, multi-step methods; systems; stability; stiff equations;
- Boundary value problems: shooting, finite difference, Rayleigh-Ritz methods.

Numerical methods for parabolic and hyperbolic partial differential equations

- Finite difference schemes: derivation and implementation; error analysis, stability, consistency, convergence, applications.

Finite Difference Discretization for the solution of Elliptic PDEs
Iterative Methods for Systems Arising from Elliptic PDEs

- Jacobi, Gauss-Seidel, S.O.R methods.

Convergence Properties and Rate of Convergence of Basic Iterative Methods.
Block Iterative Methods.
Other Advanced Point Iterative Methods.

- Simultaneous Displacement Method, Second Order Methods, Gradient Method Preconditioning;
- Preconditioned Conjugate Gradient Method.

Skills and Knowledge Acquired

At the end of this course, students should have the knowledge and skills to efficiently use numerical methods for solving differential equations. The students will also understand the theoretical foundations of the numerical methods discussed.

References

1. Rao, S. (2006). *Applied Numerical Methods for Engineers and Scientists*, Pearson International Edition.
2. Burden, R. L. & Faires, J. D. (2011). *Numerical Analysis, 9th Edition*. Thomson.
3. Sauer, T. (2018). *Numerical Analysis, 3rd Edition*, Pearson International Edition
4. Cheney, E.W. & Kincaid, D.R. (2012). *Numerical Mathematics and Computing, 7th edition*. Thomson.

LIST OF DISSERTATION SUPERVISORS (MAT510/20)

For information on academic's expertise, visit the School of Mathematical Sciences website.

https://math.usm.my/staff/academic-staff

Note:

The academic staff from the Operational Research Group of the School of Mathematical Sciences can also be contacted to obtain appropriate dissertation topics.

GUIDELINES FOR PREPARATION OF DISSERTATION(MAT 510/20 AND MST 566/20)
FOR CANDIDATES REGISTERED IN SEMESTER 1 (PART-TIME) AND SEMESTER 2 (FULL-TIME)

Introduction

The Dissertation should be completed within the stipulated time. Candidates who fail to submit their Dissertation for examination at the time set by the school will be awarded a Grade F for this course and are required to repeat the course with a new topic. This set of guidelines explains the minimum requirements that have to be fulfilled by candidates as well as the process and the aspects of examination of the Dissertation in partial fulfillment of the Master of Science (Mathematics) or Master of Science (Statistics) Degree (Mixed Mode).

Please visit www.math.usm.my for the latest guidelines.

Submission of Dissertation

Dissertations can be written either in Bahasa Malaysia or English.

All candidates have to submit a softcopy of their Dissertation for the purpose of examination together with the Dissertation Submission Form that has been signed and approved by the Supervisor to the Dean's Office. The submission date will be informed later. The title of the Dissertation and its translation should be stated in the Dissertation Submission Form (refer to Appendix B) for confirmation and approval by the Council of The School of Mathematical Sciences. The Dissertation will not be examined until the candidate fulfills all the requirements.

Research Paper should be appended to the dissertation or project report. Please refer to school 's website for the research paper template. The school will update the details from time to time through social mediums if any changes are made

Format

1. The full title of the Dissertation, full name of the candidate, name of the School of Mathematical Sciences, Universiti Sains Malaysia and the year of submission of the Dissertation must be typed in capital letters of size **18 on the front cover** as shown in the following example:

LONGITUDINAL DATA ANALYSIS
(Font size 18/single spacing)

NORAINI BINTI ABIDIN
(Font size 18/single spacing)

SCHOOL OF MATHEMATICAL SCIENCES
UNIVERSITI SAINS MALAYSIA
(Font size 18/single spacing)

2023(Font size 18)

If the Dissertation is written in Bahasa Malaysia, the example is as shown below:

ANALISIS DATA LONGITUD

NORAINI BINTI ABIDIN

PUSAT PENGAJIAN SAINS MATEMATIK
UNIVERSITI SAINS MALAYSIA

2023

2. Every Dissertation comprises four parts: **Introduction, Text, Reference** and **Appendix.** Every part has sections that have to be organized in a specific order. The heading of each section should be in capital letters, centralized without any punctuation; the text and list begin four spaces below.

3. If hardcopy is required, only good quality plain white paper (80 gsm) of A4 size (210 × 297 mm) should be used. Materials must be printed on one side of the paper only using a laser printer. All photocopies must be clear to ensure the quality of printing. All copies must be clean and legible. The **Text** should be typed, **double-spaced** using the latest version of Microsoft Word/LaTeX word processor. Candidates are encouraged to use the font **Times New Roman** and the acceptable **font size for the whole Dissertation is 11-12 points. Single-spacing** is used for long tables, long quotations, notes, footnotes, multi-line captions and bibliographic entries.

4. The **Introduction** begins with the title page as shown in the example below:

LONGITUDINAL DATA ANALYSIS
(Font size 14/single spacing)

by
(Font size 12)

NORAINI BINTI ABIDIN
(Font size 14)

Dissertation submitted in partial fulfillment
of the requirements for the degree
of Master of Science in Statistics
(Font size 12/single spacing)

October 2023
(Font size 14)

If the dissertation written in Bahasa Malaysia, the example is as shown below:

ANALISIS DATA LONGITUD

oleh

NORAINI BINTI ABIDIN

Disertasi diserahkan untuk memenuhi
sebahagian keperluan bagi
Ijazah Sarjana Sains (Statistik)

Oktober 2023

5. The **Introduction** is made up of a number of sections such as the Acknowledgment, Table of Contents, List of Tables (if any), List of Figures (if any), List of Symbols (if any), List of Abbreviations (if any), Abstrak and lastly the **Abstract**. All pages in the Introduction are numbered using lower case Roman numerals (i, ii, iii, etc). The title page of the Dissertation is considered as page i, but the number is not printed on the page.

6. All page numbers are without punctuation and placed 1 cm from bottom center. All pages including those with figures, tables, etc. must have a page number.

7. An **Abstract** in both Bahasa Malaysia and English must be provided, the former version appearing before the latter. Both versions must have their respective titles. The Abstract is a summary of the entire Dissertation and should provide a brief exposition of the research problems and aims, approaches taken to solve the problems and a summary of findings in the context of the whole area of study. Subsequent research proposals may be incorporated. This section should be double-spaced and the length of each version should not exceed 400 words. The Abstract should be placed immediately before the First Chapter of the Dissertation.

8. The **Text** is made up of a number of sections. **The organization of this section is to be determined by the student and his/her supervisor(s).** As a general guideline, the length of the text should not exceed 25,000 words. For example, the **Text** can start with an introduction that highlights the problem(s) under investigation by describing the status of the problem(s) conceptually and theoretically. Besides that, the candidate can state the scope and objectives of the study and outline the plan of action or research protocol based on the status of the problem(s). The literature review may be written as a separate chapter and the materials that have been quoted or extracted should be relevant to the research topic, objectives, method or the research protocol and the basic theory or the approach used. The literature review should include the latest research findings from books, journals, magazines, research reports and the latest materials from the internet/websites. The subsequent chapters or sections in the **Text** may include research methods, results, discussion, summary or conclusion and recommendations for future research.

9. The standard margins for the general text, tables and diagrams are as follows:

Top	:	2.5cm
Right	:	2.5cm
Left	:	4.0cm
Bottom	:	2.5cm

10. The **Bibliography** is the section after the **Text** that begins on a fresh page bearing the heading in capital letters, centralized without any punctuation marks. The list of references begins four spaces below the heading, double-spaced between entries but single-spaced within each entry. A 3-space indentation should be used for any entry exceeding a single line. The style in which the references are presented and cited must be consistent throughout the Dissertation. If a candidate makes use of other works in his/her dissertation, either in direct quotation or by reference, these sources must be listed in the Bibliography. This includes tables and figures.

11. The **Appendix** is a section that is separated from the preceding material by a cover sheet bearing the heading **APPENDICES** in capital letters (or, if there is only one, **APPENDIX**), centralized without any punctuation marks. This sheet is not numbered and also not included in the total number of pages. Appendices present materials that are referred to in the text. It contains supplementary illustrative material, notes on the interview/questionnaires, data or quotations too long for inclusion in the text or long explanations about a particular method/experiment. Appendices may be divided into Appendix A, Appendix B, etc., such divisions being treated as first order subdivisions. Each appendix with its title, if it has one, should be listed separately in the Table of Contents as a first order subdivision under the heading APPENDICES. Tables and figures in the Appendices must be numbered and have captions and also listed in the List of Tables and List of Figures in the Introduction.

Examination of the Dissertation

1. The Supervisor and the Internal Examiner appointed by the school board will be given a copy of the Dissertation for examination purposes and to be completed within 2 weeks.

2. Candidates need to present a seminar on the Dissertation that has been submitted for examination on a specific date. The seminar may include the presentation of the research background, framework, hypothesis, findings, discussions and recommendations. Each candidate is given 20 minutes for the presentation and 10 minutes for the question-and-answer session.

3. Candidates have to attend a viva in the presence of the Panel of Dissertation Examiners at the School of Mathematical Sciences. The viva will begin with a 5-minute oral presentation by the candidate regarding his/her dissertation.

4. The Panel of Dissertation Examiners comprises:

    (a) Dean (Chairperson);
    (b) Deputy Dean (Research, Innovation & Industry-Community Engagement);
    (c) Supervisor;
    (d) Internal Examiner;

4. The overall Dissertation Grade is either a Grade P (PASS) or a Grade F (FAIL).

5. After the viva, all copies of the Dissertation will be returned to the candidate.

6. Candidates who are required to re-submit their Dissertations for re-examination and/or attend a viva must submit a soft copy of the amended Dissertation together with the Dissertation Resubmission for Examination Form (refer to Appendix C) filled by the candidate and approved by the Supervisor.

7. After all corrections (if any) and the decision of the Panel of Examiners are implemented, candidates who PASS should submit the final dissertation. If a hard copy is required, the candidate must submit two (2) hard cover dissertation bound binding in red buckram or rexine together with the Final Dissertation Submission Form (refer to Appendix D). The full Dissertation title, name of the candidate, name of the university, and year of submission of the Dissertation should be **printed in gold, font size 18, on the cover page.** The name of the candidate, year of submission of the Dissertation and the degree to be awarded should also be printed in gold of suitable font size on the spine as follows:

LONGITUDINAL DATA ANALYSIS
(Font size 18/single spacing)

NORAINI BINTI ABIDIN
(Font size 18/single spacing)

SCHOOL OF MATHEMATICAL SCIENCES (Font size 18/single spacing)
UNIVERSITI SAINS MALAYSIA (Font size 18/single spacing)

2023
(Font size 18)

* Dissertation front cover.

* Spine of the Dissertation

APPENDIX A

PUSAT PENGAJIAN SAINS MATEMATIK
SCHOOL OF MATHEMATICAL SCIENCES

RANCANGAN SARJANA SAINS [STATISTIK/MATEMATIK]
(Mod Campuran)

Sidang Akademik ……

BORANG PENGESAHAN PENYELIA KURSUS DISERTASI
(Dissertation Supervisor Confirmation Form)

Kod Kursus : MST 566/20/MAT 510/20

Nama Pelajar : _____

No. K/Pengenalan : _____

No. Matrik : _____

Tandatangan Pelajar : _____

No. Tel : _____E-mel : _____

Tarikh : _____

Tajuk Disertasi : _____

_____

_____

Saya mengesahkan bahawa saya bersetuju untuk menyelia pelajar di atas pada

Sidang Akademik : _____

Nama Penyelia : _____

Tandatangan Penyelia : _____

Tarikh : _____

APPENDIX B

PUSAT PENGAJIAN SAINS MATEMATIK
SCHOOL OF MATHEMATICAL SCIENCES

BORANG PENYERAHAN DISERTASI
(Dissertation Submission Form)

KURSUS MAT510/20 & MST566/20

Kepada : Dekan
Pusat Pengajian Sains Matematik
Universiti Sains Malaysia
11800 Pulau Pinang

Nama : _____

Taraf Pencalonan (sila tandakan) : **Sambilan/Penuh Masa**

No. Matrik : _____
Alamat Terkini : _____
_____
No. Tel. : _____ E-Mel : _____
Tarikh : _____

Bersama-sama ini saya kemukakan **4 naskhah disertasi** dalam bentuk berjilid dengan pembalut yang lembut untuk tujuan penilaian.

Tajuk Disertasi : _____
_____

Terjemahan : _____
_____

1. Saya ingin mengesahkan bahawa disertasi tersebut telah pun disemak oleh Penyelia saya dan komen beliau adalah seperti yang terdapat di **Bahagian B** borang ini.

Sekian, terima kasih.

_____
(Tandatangan Calon)

BAHAGIAN B
(untuk diisi oleh Penyelia Disertasi)

Nama Penyelia : _____

Saya telah menyemak disertasi Encik/Puan/Cik _____
seorang calon Rancangan Ijazah Tinggi Sarjana Sains Matematik/Statistik.

1. Saya ingin mengesahkan bahawa saya berpuas hati dengan kemajuan yang dicapai oleh calon tersebut dan dilihat dari segi kualiti dan mutu bahasa, saya tiada halangan disertasi tersebut diserahkan untuk tujuan penilaian.

_____ _____
(Tandatangan Penyelia) (Tarikh)

BAHAGIAN C
(untuk diisi oleh Timbalan Dekan [Penyelidikan, Inovasi & Libatsama Industri-Komuniti])

Saya ingin mengesahkan perakuan yang dibuat oleh Penyelia Disertasi calon ini seperti yang tercatat di Bahagian B di atas.

_____ _____
Tandatangan Timbalan Dekan
(Penyelidikan, Inovasi & Libatsama Industri-Komuniti) (Tarikh)

APPENDIX C

PUSAT PENGAJIAN SAINS MATEMATIK
SCHOOL OF MATHEMATICAL SCIENCE

BORANG PENYERAHAN SEMULA
DISERTASI UNTUK PEMERIKSAAN

Dissertation Re-Submission Form for Examination

BAHAGIAN A
(Untuk diisi oleh calon)

Kepada : Dekan
Pusat Pengajian Sains Matematik
Universiti Sains Malaysia
11800 Pulau Pinang

Nama : _____

Alamat(terkini) : _____

Tel.Rumah : _____ Tel. Pejabat : _____

E-Mel : _____ Tarikh : _____

Bersama-sama ini saya kemukakan disertasi dalam bentuk berjilid untuk penyerahan dan pemeriksaan semula :-

Empat (4) naskhah Disertasi Ijazah Sarjana Sains [**Matematik/Statistik**] dengan pembalut lembut (berwarna merah) :

_____

_____

Terjemahan :-

_____

_____

1. Saya ingin mengesahkan bahawa semua pindaan/pembetulan telah dilaksanakan disertasi tersebut dan telahpun disemak oleh penyelia saya komen beliau adalah seperti yang terdapat pada Bahagian B borang ini.

Sekian, terima kasih.

_____
(Tandatangan Calon)

BAHAGIAN B

(Untuk diisi oleh Penyelia Utama)

Nama Penyelia : _____

Pusat Pengajian

Saya telah menyemak semua pembetulan/pindaan yang dibuat oleh Encik/Puan/Cik _____ dalam disertasinya yang diserah semula untuk pemeriksaan sebagaimana yang dipersetujui oleh Jemaah Pemeriksaan Disertasi.

1. Saya ingin mengesahkan bahawa saya berpuas hati dengan pembetulan/pindaan yang dibuat oleh calon dan tiada halangan disertasi tersebut diserahkan untuk pemeriksaan semula.

Sekian, terima kasih.

_____ _____

(Tandatangan Penyelia) (Tarikh)

BAHAGIAN C

(Untuk diisi oleh Timbalan Dekan [Penyelidikan, Inovasi & Libatsama Industri-Komuniti])

Saya ingin mengesahkan perakuan yang dibuat oleh penyelia disertasi calon ini seperti yang tercatat di Bahagian B di atas:-

_____ _____

Tandatangan Timbalan Dekan (Tarikh)

[*Penyelidikan, Inovasi & Libatsama Industri-Komuniti*]

APPENDIX D

PUSAT PENGAJIAN SAINS MATEMATIK
SCHOOL OF MATHEMATICAL SCIENCES

BORANG PENYERAHAN DISERTASI MUTAKHIR
(DUA (2) NASKHAH)
(Final Dissertation Submission Form)

BAHAGIAN A
(Untuk diisi oleh calon)

Nama : _____

Bidang Pengajian : Sarjana Sains (Statistik / Matematik) (tandakan yang berkenaan)

Alamat (terkini) : _____

_____

No. Tel. : _____ E-Mel : _____

Tarikh : _____

Bersama-sama dengan ini saya kemukakan :-

i) **Dua (2)** naskhah berjilid dengan pembalut khas dan satu (1) cakera padat disertasi Ijazah Sarjana Sains [**Matematik/Statistik**] bertajuk :-

_____

_____

Terjemahan :-

_____

_____

ii) Saya ingin mengesahkan bahawa disertasi tersebut telahpun disemak oleh Penyelia Utama saya dan Dekan Pusat Pengajian, komen mereka adalah seperti yang terdapat pada Bahagian B dan C borang ini.

Sekian, terima kasih.

_____

(Tandatangan Calon)

BAHAGIAN B

(Untuk diisi oleh Penyelia Utama)

Nama Penyelia : _____

Pusat Pengajian : _____

Saya telah menyemak semua pembetulan/pindaan yang dilaksanakan oleh Encik/Puan/Cik _____ mengenai disertasinya sebagaimana yang dipersetujui oleh Jemaah Pemeriksaan Disertasi.

1. Saya ingin mengesahkan bahawa saya berpuas hati dengan pembetulan/pindaan yang dilaksanakan oleh calon.

Sekian, terima kasih.

_____ _____

(Tandatangan Penyelia) (Tarikh)

BAHAGIAN C

(Untuk diisi oleh Dekan/Timbalan Dekan Pusat Pengajian)

Saya _____ Dekan/Timbalan Dekan Pusat Pengajian Sains Matematik ingin :-

(i) Mengesahkan perakuan yang dibuat oleh Penyelia Calon;

(ii) Mengesahkan bahawa saya berpuashati dengan pembetulan/pindaan yang dilaksanakan oleh calon sebagaimana yang dipersetujui oleh Jemaah Pemeriksaan Disertasi.

_____ _____

(Tandatangan Dekan/Timbalan Dekan) (Tarikh)