

# INSTITUTE OF MATHEMATICAL SCIENCES

The Institute of Mathematical Sciences 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, Pure Mathematics, Applied Mathematics and Statistics. The Institute offers 6 first degree programmes. The Institute also offers various service courses to other faculties including the Faculty of Engineering.

For the 2009/2010 session, the Institute offers the following first degree programmes:

- Bachelor of Science (Mathematics)
- Bachelor of Science (Industrial and Computing Mathematics)
- Bachelor of Science (Statistics)
- Bachelor of Science (Actuarial and Financial Mathematics)
- Bachelor of Science with Education (Mathematics)
- Bachelor of Arts (Mathematics)

The four Bachelor of Science programmes are set up to provide more opportunities for an undergraduate to major in the field of mathematics according to his or her interests. In addition, the Bachelor of Science in Education (Mathematics) is a programme that enables a student to expand and consolidate his or her mathematical knowledge in line to become a graduate educator. All these programmes 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 an industrial nation.

## STAFF

The Institute has a group of experience 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. The Institute also strives to establish and forge a close relationship with industry and other research institutions. This will strengthen the quality of teaching and supervising of projects/theses for students in Bachelors, Masters and Doctoral levels.

## HEAD:

**Professor Dr. Ong Seng Huat**, BSc, MSc, PhD

## DEPUTY HEAD:

**Professor Dr. Suzeini Abd Halim**, BSc(NSW), PhD(Wales)

**Assoc. Prof. Abdul Hadi Yaakub**

BSc.(Nevada), Msc(Illinois)

## PURE MATHEMATICS

### COORDINATOR:

**Professor Dr. Lim Ming Huat**, BSc(Nan), PhD(BrCol)

### PROFESSOR:

**Dr. Angelina Chin Yan Mui**, BSc, MSc, PhD(Q'ld)

**Dr. Chia Gek Ling**, BSc, MSc, PhD, FTICA

**Dr. Lim Ming Huat**, BSc(Nan), PhD(BrCol)

**Dr. Suzeini Abd Halim**, BSc(NSW), PhD(Wales)

**Dr. Wong Peng Choon**, BSc, MSc, PhD(NYU)

### ASSOCIATE PROFESSOR:

**Dr. Chooi Wai Leong**, BSc, MSc, PhD

**Dr. Daud Yahaya**, BSc, DipEd(UKM),

MSc(Sheff), PhD (St. And)

**Dr. Deng Chai Ling**, BSc, MSc, PhD

**Dr. Kon Song How**, BSc, MSc, PhD

### LECTURER:

**En. Mohamad Bakri Zubir**, BSc, MSc(Exeter)

**Dr. Ong Siew Hui**, BSc, MSc, PhD

**Dr. Loo Tee How**, BSc, MSc, PhD

**Dr. Oon Shea Ming**, BSc, MSc, PhD(UHP)

**Dr. Wong Kok Bin**, BSc, MSc, PhD

## APPLIED MATHEMATICS

### COORDINATOR:

**Assoc. Prof. Dr. Mohd Omar**, BSc, MSc(Hull), PhD(Exeter)

### PROFESSOR:

**Dr. Bernardine R. Wong Cheng Kiat**, BSc, MSc, PhD, CPhys, MInstP

**Dr. Kurunathan Ratnavelu**, BSc, MSc,

PhD(Flinders), CPhys, MInstP, FASc

### ASSOCIATE PROFESSOR:

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

**Dr. Nordin Haji Mohamad**, BSc, MSc(Lond), PhD(City)

**Dr. Noor Hasnah Moin**, BSc, MSc(Sussex), PhD(Sheff)

**Dr. Rio Hirowati Shariffudin**, BSc, MSc(Lond), PhD(UKM), DIC

**Dr. Siti Aishah Hashim Ali**, BSc(Virginia), MSc(Miami), PhD

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

**LECTURER:**

**Dr. Amran Hussin**, *BSc, MSc (Soton), PhD (Soton)*

**Pn. Che Wan Mariam Saad**, *BA(Chico), MSc(Irvine)*

**En. Mohd Abu Omar Awang**, *BSc(Lond), MPhil(East Anglia), ARCS*

**Dr. Mohd. Khanafiah Ismail**, *BSc, MSc(Brun), PhD(Dundee)*

**Pn. Siti Suzlin Supadi**, *BSc, MSc*

**En. Zailan Siri**, *BSc, MSc*

**STATISTICS**

**COORDINATOR (B.Sc STATISTICS):**

**Prof. Dr. Sim Chiaw Hock**, *BSc(Nan), MA(Lancaster), PhD*

**COORDINATOR (B.Sc ACTUARIAL AND FINANCIAL MATHEMATICS)**

**Dr. Noor Azlinna Azizan**, *BBA (WMU), MSc (Southampton), PhD (Liverpool)*

**PROFESSOR:**

**Dr. Nor Aishah Hamzah**, *BSc(Southampton), MSc(Leeds), PhD(Bristol), DipEd(UKM), MIS(UK)*

**Dr. Ong Seng Huat**, *BSc, MSc, PhD*

**Dr. Sim Chiaw Hock**, *BSc(Nan), MA(Lancaster), PhD*

**Dr. Pooi Ah Hin**, *BSc, MSc, PhD(London)*

**ASSOCIATE PROFESSOR:**

**En. Abdul Hadi Yaakub**, *BSc(Nevada), MSc(Illinois)*

**Dr. Ibrahim Mohamed**, *BSc(Bristol), MSc(Reading), PhD (UITM)*

**Dr. Nik Ahmad Kamal Nik Mohd. Amin**, *BSc, PhD(Wales)*

**Dr. Omar Mohd. Rijal**, *BSc(Ulster), PhD(Glasgow)*

**LECTURER:**

**Pn. Rose Irnawaty Ibrahim**, *BSc, MSc (Herriot-Watt)*

**Pn. Wu Swee Leng**, *BSc, MSc*

**Dr. Ng Kok Haur**, *BSc, MSc(UPM), PhD*

**Dr. Noor Azlinna Azizan**, *BBA (WMU), MSc (Southampton), PhD (Liverpool)*

**Dr Adriana Irawati Nur Ibrahim**, *BSc(USM), MSc, PhD(Bath)*

**COORDINATOR ((B.Sc. Ed (Mathematics))**

**Dr. Amran Hussin**, *BSc, MSc (Soton), PhD (Soton)*

**COMPUTER FACILITIES**

To date the Institute has a computer lab equipped with 6 tablet PCs, 10 laptops, 2 workstations, 90 Pentium IV computers, 3 laser printers, 1 colour printer, 4 heavy duty dot matrix printers, all interconnected in a network system. The lab is also equipped with 5 LCD projectors, 1 visualizer, and 2 scanners. The lab utilizes state of the art

software such as Matlab (with various Toolboxes), Mathematica v6, MathType v5.2, Minitab R14, Visual C++, S-PLUS v8, Scientific Word 5.5, PcTeX 32 and MathCAD v13. In addition, three of the lecture halls are equipped with a LCD projector and a visualizer each. Level II and III students specialising in the programmes of the Institutes are provided with internet access.



**BACHELOR OF SCIENCE PROGRAMMES**

Please refer to programme charts for courses.

**FURTHER DEGREE**

Apart from teaching and supervising in the Bachelors level, the staff of the Institute also supervise research projects that lead to Masters and Doctorate degrees in the three branches of mathematics.

The modes for further degree programmes at the Institute are by research with dissertation or theses.

**JOB OPPORTUNITIES**

The learning of mathematics will help increase one's skills in problem solving and analysis. It trains the 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 career opportunities are almost limitless and not only confined to teaching and research. Many graduates from this Institute have found employment in the financial sectors (banking, accountancy and insurance for instance), management, business, industry and computing sectors.

## SYNOPSIS OF COURSES

### **SSEX1102 - STATISTICS (FACULTY OF SCIENCE) (3 CREDITS)**

**Prerequisite:** *STPM Mathematics T/S or equivalent*

Introduction to Statistics. Presentation and organization of data. Descriptive statistics. Population versus sample. Measures of location and dispersion. Introduction to probability. Axioms of probability. Probability distribution: Binomial, Poisson and normal. Sampling distribution, central limit theorem. Estimation of population mean and proportion. Confidence interval. Hypothesis testing of mean and proportion. Inferential statistics involving two populations. Hypothesis tests using the chi-square distribution.

#### References:

1. Prem S. Mann, *Introductory Statistics*, 6<sup>th</sup> ed., Wiley, 2006.
2. R.A. Johnson, *Statistics: Principles and Methods*, 5<sup>th</sup> ed., Wiley, 2005.

#### Assessment:

Continuous Assessment:	30%
Final Examination:	70%

### **SJES1210 - FOUNDATION MATHEMATICS (2 CREDITS)**

**Prerequisite:** *STPM Mathematics T/S or equivalent*

Elementary logic. Mathematical statements. Quantifiers. Sets and functions. Cartesian products. Invertible functions. Mathematical induction. Binomial theorem. Integers, rational numbers, real numbers. Complex numbers. Roots of unity. Polynomials and equations.

#### References:

1. Douglas E. Ensly, J. Winston Crawley, *Discrete Mathematics*, John Wiley and Sons, 2006.
2. K. Devlin, *Sets, Functions and Logic*, 2<sup>nd</sup> ed., Chapman & Hall, 1992.
3. K. Bevan Youse, *Algebra and the Elementary Functions*, Dickenson Publ. Co., 1996.
4. Will J. Gilbert, Scott A. Vanstone, *Introduction to Mathematical Thinking: Algebra and Number Systems*, Pearson Prentice Hall Inc, 2005.

#### Assessment:

Continuous Assessment:	30%
Final Examination:	70%

### **SJES1215 - LINEAR ALGEBRA I (3 KREDIT)**

**Prerequisite:** *STPM Mathematics T/S or equivalent*

Algebra of matrices, echelon forms and special matrices. System of linear equations. Elementary matrices. Matrix inverse. Linear independence.

Rank and determinant. Adjoint and Cramer's Rule. Eigenvalues and eigenvectors. Diagonalisation. Some applications of matrices.

#### References:

1. H. Anton & R.C. Busby, *Contemporary Linear Algebra*, 1<sup>st</sup> ed., John Wiley & Sons Inc., 2003.
2. D. Poole, *Linear Algebra, A Modern Introduction*, 3<sup>rd</sup> ed., Brooks/Cole Thomson Learning, 2003.
3. G. Nakos & D. Joyner, *Linear Algebra with Applications*, 1<sup>st</sup> ed., Brooks/Cole, Thomson Learning, 1998.

#### Assessment

Continuous Assessment:	30%
Final Examination:	70%

### **SJES1221 - CALCULUS I (4 CREDITS)**

**Prerequisite:** *STPM Mathematics T/S or equivalent*

Inequality and absolute values. Lines and circles. Parabola, ellipse, hyperbola. Functions and their graphs. Combining Functions. Various types of Functions. Limits and Continuity. Derivatives. Differentiation Rules including the Chain Rule and Leibniz Rule. Rolle's Theorem, The Mean Value Theorem, Maximum, minimum, concavity and points of inflection. Graph sketching. L'Hopital's Rule.

#### References:

1. Maurice D. Weir, Joel Hass, F.R Giordano, *Thomas Calculus*, 11<sup>th</sup> ed., Pearson Education, Inc. 2005.
2. H. Anton, I. Bivens, S. Davis, *Calculus*, 8<sup>th</sup> ed., John Wiley & Sons, 2005.
3. J. Stewart, *Calculus*, 6<sup>th</sup> ed., Brooks/Cole, 2008

#### Assessment

Continuous Assessment:	40%
Final Examination:	60%

### **SJES1222 - CALCULUS II (4 CREDITS)**

**Prerequisite:** *SJES1221*

Definite and indefinite integrals. Fundamental theorem of Calculus and differentiation of integrals. Differentiation methods. Improper integrals. Infinite series. Taylors approximation and power series. Three dimensional vector geometry. Triple product. Equations of planes and straight lines in three dimensional space. Polar coordinates.

References:

1. George B. Thomas, Jr., *Thomas' Calculus*, 11<sup>th</sup> ed., Pearson Education, Inc., 2005.
2. G. B. Thomas & R.L. Finney, *Calculus and Analytic Geometry*, 9<sup>th</sup> ed., Addison-Wesley Publ. Co., 1996.
3. J. Stewart, *Calculus*, 6<sup>th</sup> ed., Brooks/Cole, 2008.
4. H. Anton, I. Bivens, S. Davis, *Calculus*, 8<sup>th</sup> ed., John Wiley & Sons, 2005.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES1231 - APPLIED DIFFERENTIAL EQUATIONS (2 KREDIT)**

**Prerequisite: STPM Mathematics T/S or equivalent**

Fundamental concepts and definitions in ODE, First order ODE: separable, linear first order, Bernoulli equation, exact and non exact, homogenous and equation with linear coefficients. Applications of ODE: Mixing problems, Newton's Law. Kinematic and dynamic.

Linear Second order ODE with constant coefficients: Fundamental concepts and definitions. Solutions. Wronskian. The method of undetermined coefficients.

References:

1. R.K. Nagle & E.B. Saff, *Fundamentals of Differential Equations and Boundary Value Problems*, 2<sup>nd</sup> ed., Reading: Addison-Wesley, 1996.
2. M.R. Spiegel, *Applied Differential Equations*, 3<sup>rd</sup> ed., New York: Prentice-Hall, 1981.
3. W. Hauser, *Introduction to the Principles of Mechanics*, Reading: Addison-Wesley, 1965.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES1250 - INTRODUCTORY PROBABILITY (2 CREDITS)**

**Prerequisite: STPM Mathematics T/S or equivalent**

Probability: Properties of probability. Counting techniques. Conditional probability. Independent events. Bayes Theorem. Discrete distributions: Discrete random variables. Mathematical Expectation. Min, variance and standard deviation. Uniform discrete distribution, hypergeometric, Bernoulli, binomial, geometric, negative binomial, Poisson. Moment generating function. Continuous distribution: Continuous random variables. Uniform distribution, exponential, gamma, Chi-squared, Normal. Distribution of Functions of a random variable.

References:

1. R.V. Hogg & E.A. Tanis, *Probability and Statistical Inference*, 4<sup>th</sup> ed., Macmillan, 1990.
2. P. Meyer, *Introductory Probability and Statistical Applications*, 2<sup>nd</sup> ed., Addison-Wesley, 1970.
3. H.J. Larson, *Introduction to Probability Theory & Statistical Inference*, 3<sup>rd</sup> ed., Wiley, 1982.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES1310 - UNDERSTANDING COMPUTER IN MATHEMATICS (2 CREDITS)**

**Prerequisite: STPM Mathematics T/S or equivalent**

Introduction to computers; Use of mathematical based software such as MATLAB / MAPLE / MATHEMATICA for solving problems in mathematics. Introduction to spreadsheet software such as MS-Excel.

References:

1. T. Duffy, *Tim Duffy Lab Series:Excel 97*, Addison-Wesley, 1996.
2. E. Part-Enander, A. Sjöberg, B. Melin, & M. Isaksson, *The Matlab Handbook*, Addison-Wesley, 1996.
3. D. Hamselman and B. Littlefield, *The Student Edition of MATLAB Version*, Prentice Hall, 1997.
4. H.L. Capron, *Computers: Tools for an information age*, 5<sup>th</sup> ed., Addison-Wesley, 1998.
5. P.R. Toliver & Y. Johnson, *Select Lab Series: Projects for Microsoft Excel 97*, Addison-Wesley, 1998.

Assessment:

Continuous Assessment:	50%
Final Examination:	50%

**SJES2215 - LINEAR ALGEBRA II (3 CREDITS)**

**Prerequisite: SJES1215**

Vector spaces and subspaces. Basis and dimension. Linear transformations and matrix representation. Rank and nullity. Eigenvalues and eigenvectors. Diagonalization. Cayley-Hamilton Theorem and applications.

References:

1. H. Anton, *Elementary Linear Algebra*, 9<sup>th</sup> ed., John Wiley & Sons Inc., 2004.
2. S.H. Friedberg, A.J. Insel, L.E. Spence. *Linear Algebra*, 4<sup>th</sup> ed., Prentice Hall, Inc., 2003.
3. D.C. Lay *Linear Algebra and its Applications*, 3<sup>rd</sup> ed., Pearson Education, Inc., 2006.
4. D. Poole, *Linear Algebra – A Modern Introduction*, Thomson Brooks Cole, 2006.
5. W.K. Nicholson, *Linear Algebra with Applications*, 5<sup>th</sup> ed., McGraw-Hill, Inc., 2006

Assessment:

Continuous Assessment:	30%
Final Examination:	70%

**SJES2216 - ALGEBRA I (3 CREDITS)**

**Prerequisite: SJES1210 or SJES1215**

Set Theory and elementary properties of numbers. Groups and subgroups. Order of an element. Lagrange's Theorem on the order of a subgroup in a finite group. Normal subgroups and factor groups. First Isomorphism Theorem. Different types of rings including commutative rings, integral domains, division rings and fields. Subrings, ideals and quotient rings. Ring homomorphisms. Rings of polynomials.

References:

1. J. R. Durbin, *Modern Algebra, An Introduction*, 2<sup>nd</sup> ed., John Wiley & Sons Inc., 1985.
2. J. B. Fraleigh, *A First Course in Abstract Algebra*, 5<sup>th</sup> ed., Addison-Wesley Publ. Co., 1993.
3. I.N. Herstein, *Abstract Algebra*, 2<sup>nd</sup> ed., Macmillan, 1990.

Assessment:

Continuous Assessment:	30%
Final Examination:	70%

**SJES2223 - CALCULUS III (4 CREDITS)**

**Prerequisite: SJES1222**

Quadric surfaces - cylinders, ellipsoids, cones etc. Cylindrical and spherical coordinates. Algebra of vector valued functions in three dimensional space. Differentiation of vector valued functions. Functions of several variables. Continuity, partial derivatives, tangent plane, directional derivatives. Total differential. Chain rule, implicit differentiation. Taylor's Theorem, extremum problems, Lagrange multipliers. Multiple and iterated integrals. Jacobian and change of variables

References:

1. G.B. Thomas & R.L. Finney, *Calculus and Analytic Geometry*, 9<sup>th</sup> ed., Addison-Wesley Publ. Co., 1996.
2. J. Stewart, *Multivariable Calculus*, 4<sup>th</sup> ed., Brooks/Cole 1999.
3. H. Anton, *Calculus* 6<sup>th</sup> ed., John Wiley & Sons Inc., 1999.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2224 - INTRODUCTION TO ANALYSIS (3 CREDITS)**

**Prerequisite: SJES1222**

Algebra of sets, function and inverse of functions. Real number system; algebraic, order and

completeness properties of R. Bounded set and supremum property. Countability of set. Sequences and their limits. Subsequence and Bolzano - Weierstrass Theorem. Continuity and uniform continuity.

References:

1. W.A.J. Kosmala, *A Friendly Intro to Analysis*, 2<sup>nd</sup> Edition, Pearson Education International, 2004.
2. Edward D. Gaughan, *Introduction to Analysis*, 5<sup>th</sup> ed., Brooks/Cole, 1998.
3. R. Haggarty, *Fundamentals of Mathematical Analysis*. 2<sup>nd</sup> ed., Addison-Wesley Publ. Co., 1993.
4. R.G. Bartle & D.R. Sherbert, *Introduction to Real Analysis* 2<sup>nd</sup> ed., John Wiley & Sons Inc., 1992.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2234 - COMPUTATIONAL METHODS I (3 CREDITS)**

**Prerequisite: SJES1222**

Elements of Computer Arithmetic, Notations and Symbols Generated out of Taylor's Series, Interpolations for Equal Step lengths, Interpolations for Unequal Step lengths, Numerical Differentiation. Richardson's Extrapolation, Numerical Integration for Equal Step lengths, Numerical Integration for Unequal Step lengths, Roots of single Variable Nonlinear Equations, Roots of Linear Systems-Direct and Indirect Methods

References:

1. K.E. Atkinson, *Elementary Numerical Analysis*, 2<sup>nd</sup> Edition, John Wiley & Sons, 1993.
2. R.L. Burden & J.D. Faires, *Numerical Analysis*, 5<sup>th</sup> Edition, PWS-Kent, Boston, 1993.

Assessment:

Continuous Assessment:	30%
Final Examination:	70%

**SJES2235 - ENGINEERING MATHEMATICAL METHODS I (3 CREDITS)**

**Prerequisite: SJES1222, SJES1231 and SJES1215**

Linear Differential Equations: series method and Frobenius method. Gamma Function, Bessel Functions and Legendre Polynomials. Linear Differential Equations of order n. The techniques of variation of parameters. Systems of linear differential equations with constant coefficients.

References:

1. R. K. Nagle, E. B. Saff & A. D. Snider, *Fundamentals of Differential Equations and Boundary Value Problems*, 4<sup>th</sup> ed., Addison-Wesley, 2003.
2. M. L. Boas, *Mathematical Methods in the Physical Sciences*, 3<sup>rd</sup> ed., Wiley, 2006.
3. M. R. Spiegel, *Applied Differential Equations*, 3<sup>rd</sup> ed., Prentice-Hall, 1981.
4. W. E. Boyce & R. C. Di Prima, *Elementary Differential Equations and Boundary Value Problems*, 8<sup>th</sup> ed, John Wiley & Sons, 2005.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2236 - INTRODUCTION TO OPERATIONAL RESEARCH (2 CREDITS)**

**Prerequisite: SJES1215**

Introduction to the problems in operational research, modeling, formulation and examples. Solution procedure : By graph, algebra, simplex, tree diagram, payoff matrix, simulation, and heuristic. Some case study; decision analysis, linear programming, transportation problem, integer programming, game theory and dynamic programming.

References:

1. H.A. Taha, *Penyelidikan Operasi Pengenalan* (terjemahan Muhamad Jantan), USM, Pulau Pinang dan Dewan Bahasa dan Pustaka, 1993.
2. W.L. Winston, *Operational Research: Applications and Algorithms*, Duxbury Press, 1994.
3. F.S. Hillier and G.J. Lieberman, Holden-Day Inc. California, USA.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2250 - PROBABILITY AND STATISTICS I (3 CREDITS)**

**Prerequisite: SJES1250**

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. t and F distributions. Multivariate Distribution: Two dimensional random variables and n-dimensional random variables. Trinomial and multinomial distributions. Correlation coefficient. Conditional distribution. Bivariate normal distribution. Transformation of random variables. Point estimation: Bias and unbiased estimators. Method of moment. Method of maximum likelihood.

Reference:

1. R.V. Hogg & E.A. Tanis, *Probability and Statistical Inference*, 4<sup>th</sup> ed., Macmillan, 1990.
2. P. Meyer, *Introductory Probability and Statistical Applications*, 2<sup>nd</sup> ed., Addison-Wesley, 1970.
3. H.J. Larson, *Introductory to Probability Theory and Statistical Inference*, 3<sup>rd</sup> ed. Wiley.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2251 - PROBABILITY AND STATISTICS II (3 CREDITS)**

**Prerequisite: SJES2250**

Interval estimation (mean, variance, difference between two mean from the normal distribution, proportions, difference between two proportions ). Hypothesis testing ( for the mean, proportions, variance of one population), Power of the tests and determining the sample size. Testing the equality of the means and variances using samples that were chosen from two normal distribution. Chi-square goodness-of-fit tests and contingency tables.

References:

1. R.V. Hogg & E.A. Tanis, *Probability and Statistical Inference*, 4<sup>th</sup> ed., Macmillan, 1990.
2. P. Meyer, *Introductory Probability and Statistical Applications*, 2<sup>nd</sup> ed., Addison-Wesley, 1970.
3. R.V. Hogg & T.C. Craig, *Introduction to Mathematical Statistics*, 5<sup>th</sup> ed., Prentice-Hall, 1995.
4. H.J. Larson, *Introductory to Probability Theory and Statistical Inference*, 3<sup>rd</sup> ed. Wiley.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2271 - SCIENTIFIC COMPUTING I (3 CREDITS)**

**Prerequisite: SJES1221**

C++ Programming language: Elements, structures, development and testing. Application: Numerical applications, data processing and simulation.

References:

1. John R. Hubbard, *Programming with C++, 2<sup>nd</sup> ed.*, McGraw-Hill, 2000.
2. James P. Cohoon and Jack W. Davidson, *C++ program design: an introduction to programming and object-oriented design*, (3<sup>rd</sup> Ed.), McGraw-Hill, 2002.
3. Harvey Deitel and Paul Deitel, *C++ How to Program*, 4<sup>th</sup> ed., Pearson, 2003.

4. Frank L. Friedman and Elliot B. Koffman, *Problem solving, abstraction and design using C++*, 3<sup>rd</sup> ed., Addison-Wesley, 2000.
5. William H. Press, Saul A. Teukolsky, William T. Vetterling and Brian P. Flannery, *Numerical Recipes in C++: The Art of Scientific Computing*, Cambridge University Press, 2002

Assessment:

Continuous Assessment:	50%
Final Examination:	50%

**SJES2272 - INTRODUCTION TO STATISTICAL COMPUTING (3 CREDITS)**

**Prerequisite: SXEX1102**

JAVA programming language: Object, class and method, selection statements, loops, data type, arrays, graphics, input and output, threads, multimedia. Applications: Iterative methods for finding maximum likelihood estimates and least squares estimates in various models.

References:

1. B.S. Everitt, *Introduction to Optimization methods and their application in statistics*. Chapman and Hall.
2. R. Garside & J. Mariani, *JAVA: First contact*. Course Technology.
3. P. Sellappan, *Programming in JAVA*. Sejana Publishing.
4. J. R. Hubbard, *Programming with JAVA* (Schaum's Outline Series). McGraw-Hill International Editions.

Assessment:

Continuous Assessment:	50%
Final Examination:	50%

**SJES2362 - INTEREST THEORY AND DERIVATIVES (INTRODUCTORY FINANCIAL MATHEMATICS) (3 CREDITSS)**

**Prerequisite: SJES1221**

Measures of interest and problems solving involving interest. Expansion of basic principles of interest to more complicated financial transactions. Annuity-certain, Amortization and sinking fund; bond and security. Introduction to derivatives, forwards, futures, short and long positions, call and put options, spreads, collars, hedging, arbitrage and swaps.

References:

1. Broverman, Samuel A., *Mathematics of investment and credit* 3<sup>rd</sup> ed. Winsted, Conn. : ACTEX, 2004
2. G. Kellison, *Theory of Interest*, 2<sup>nd</sup> Ed., Homewood IL:Irwin, 1991.
3. Cissell & Cissell, *Mathematics of finance*, 3<sup>rd</sup> Ed., Houghton Mifflin, 1969.
4. Shao & Shao, *Mathematics for management and finance*, 8<sup>th</sup> Ed., ITP, 1997

5. Robert, L.M. (2006) *Derivatives markets*, second edition, Addison Wesley.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2367 - MIKROECONOMICS (3 CREDITS)**

**Prerequisite: STPM Mathematics T/S or equivalent**

Supply and demand curve, equilibrium point, utility function, Budget estimation line, maximum utility, Income and Effect, Estimation of production function variance budgeting, competitive firm, Income, cost, supply, profit, short-term and long-term analysis, equilibrium, monopolistic, oligopolistic.

References:

1. N. Gregory Mankiw, *Principles of Microeconomics*, Dryden Press, Fort Worth, 1998.
2. Taylor, John B, *Principles of Microeconomics*, 2nd ed, Boston, Houghton Mifflin, 1998.
3. Pindyck, R.S. and Rubinfeld, D.L. *Microeconomics*, ed., Maxwell Macmillan, 1995.
4. Katz, Michael L. and Rosen, Harvey S., *Microeconomics*, ed., 1999.
5. Landsburg, S.E. *Price Theory and Applications*, 5th ed., International Thomson Publishing, 2002.

Assessment

Continuous Assessment:	40%
Final Examination:	60%

**SJES2368 – MACROECONOMICS (3 CREDITS)**

**Prerequisite: STPM Mathematics T/S or equivalent**

Keynesian Model, Investment effect, Government expenditure and net export on GPP, relationship between interest rate, money demand, Consumption and Investment; Foreign exchange rate effect on GDP/NI, Money supply tools and process on Inflation, money velocity and role of central bank.

References:

1. Mc Eachern. *Macroeconomics; A Contemporary approach*. 7<sup>th</sup> ed. Thomson, 2007.
2. Richard T. Froyen, *Macroeconomics: Theories and Policies*, 6th ed., Prentice Hall, 1999.
3. Wachtel, P., *Macroeconomics*, Society of Actuaries. Study Note 2-21-00 (Third or Fourth Printing).
4. Rudiger Dornbusch & Stanley Fischer, *Macroeconomics*, 7th ed., McGraw-Hill, 1998.

5. Case, Karl E. Principles of Macroeconomics, Pearson Prentice Hall, 2007.

Assessment:

Continuous Examination:	40%
Final Examination:	60%

**SJES2369 – INTRODUCTION TO ACCOUNTING (3 CREDITS)**

**Prerequisite: STPM Mathematics T/S or equivalent**

Principle of basic accounting including role of accounting standard, types and differences of business entities. Basic structure and limit of company account.

References

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

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2411 – INTRODUCTION TO COMBINATORICS (3 CREDITS)**

**Prerequisite: SJES1210 or SJES1215**

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.

References:

1. C.C. Chen, & K.M. Koh, *Principles and Techniques in Combinatorics*, World Scientific, 1992.
2. S. Lipschutz & M.L. Lipson, *Discrete Mathematics (2000 Solved Problems)*, Schaum's Solved Problems Series, McGraw-Hill Book Co., 1992.
3. W.W. Rouse & H.S.M. Coxeter, *Mathematical Recreations and Essays*, 12<sup>th</sup> ed., Univ. of Toronto Press, 1974.

Assessment:

Continuous Assessment:	30%
Final Examination:	70%

**SJES2425 - COMPLEX VARIABLES (3 CREDITS)**

**Prerequisite: SJES1222**

Complex number system (Review). Complex function, limits, continuity, differentiability and analytic function. Cauchy-Riemann equations, Harmonic functions. Mapping and other properties of elementary functions. Complex Integration, Cauchy's Theorem, Cauchy's Integral Formula. Sequences and series of complex functions. Power Series. Taylor and Laurent Series. Zeros and singularities. Residue Calculus.

References:

1. John H. Mathews, and Russel W. Howell *Complex Variables for Mathematics & Engineering*, 6<sup>nd</sup> ed., Jones and Bartlett Pub. Inc.
2. A. David Wunsch, *Complex variables with Applications*, 3<sup>rd</sup> ed., Pearson Addison-Wesley.
3. R.V. Churchill, J.W. Brown & R.F. Verhey, *Complex Variables and Applications*, 6<sup>th</sup> ed., McGraw-Hill Book Co., 1990.
4. Nguyen Huu Bong, *Analisis Kompleks dan Penerapan*, Dewan Bahasa dan Pustaka, 1994.
5. Aminuddin Resang, *Pembolehubah Kompleks Permulaan: Jilid I & II*. Dewan Bahasa & Pustaka 1995.

Assessment:

Continuous Assessment:	30%
Final Examination:	70%

**SJES2426 - THEORY OF DIFFERENTIAL EQUATIONS (3 CREDITS)**

**Prerequisite: SJES1222 dan SJES1231**

Existence and uniqueness theorem. Solutions for linear differential equations with constant coefficient. Autonomous linear equations and linear approximation in two dimensions, types of critical points, stability.

References:

1. D. Zill, *A First Course in Differential Equations with Modeling Applications*, 7<sup>th</sup> ed., Brooks/Cole, 2001.
2. G.F. Simmons, *Differential Equations with Applications and Historical Notes*, 2<sup>nd</sup> ed., McGraw-Hill Book Co., 1991.
3. P. Bugl, *Differential Equations*, Prentice Hall, 1995.

Assessment:

Continuous Assessment:	30%
Final Examination:	70%

### **SJES2427 - GEOMETRY (3 CREDITS)**

**Prerequisite: SJES1221**

Euclidean Geometry, Congruence, parallelism, similarity, isometry, inversion, geometric construction.

References:

1. C.W. Dodge, *Euclidean Geometry and Transformations*, Addison-Wesley Publ. Co., 1972.
2. H.S.M. Coxeter, *Introduction to Geometry*, 2<sup>nd</sup> ed., John Wiley and Sons, 1969.
3. A.R. Hoffer, *Geometry, A Model of the Universe*, Addison-Wesley Publ. Co., 1979.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

### **SJES2433 - CLASSICAL MECHANICS (3 CREDITS)**

**Prerequisite: SJES1222**

Newton's law of motion, Particle motion in one, two and three dimensions, Central force, Motion of system of particles, Moving coordinates system.

References:

1. G.R. Fowles & G.L. Cassiday, *Analytical Mechanics*, 7<sup>th</sup> ed., Brooks Cole Publishers 2004.
2. Phil Dyke and Roger Whitworth, *Guide to Mechanics*, Palgrave 2001.
3. Tai L. Chow, *Classical Mechanics*, John Wiley & Sons, 1995.
4. M.R. Spiegel, *Theoretical Mechanics*, Schaum Seies, 1983.
5. T. W. B. Kibble and F. H. Berkshire, *Classical Mechanics*, 4<sup>th</sup> ed., Addison Wesley Longman, 1996.

Assessment:

Continuous Assesement: 40%  
Final Examination: 60%

### **SJES2434 - VECTOR CALCULUS (3 CREDITS)**

**Prerequisite: SJES1222**

Vector Algebra - Dot and Cross Products. Vector identities. Vector differentiation-curves, planes, surfaces, space, tangent, curvature, velocity and acceleration. Scalar Fields: definition and gradient. Vector Fields: Divergence and Curl. Line, surface and volume integrals. Divergence theorem. Green theorem. Stokes theorem.

References:

1. Harry F. Davis & Arthur David Snider, *Introduction to Vector Analysis*, 7<sup>th</sup> ed, Wm. C. Brown Pub. 1995.
2. Murray R. Spiegel, *Vector Analysis*, Schaum's Outline Series, McGraw-Hill, 1959.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

### **SJES2435 - MATHEMATICAL MODELLING I (3 CREDITS)**

**Prerequisite: SJES1222 or SJES1231**

Building of Mathematical Models: identifying variables, obtain relationship between the variables - ordinary differential equations and systems of first degree differential equations. Solutions and interpretations.

References:

1. R.K. Nagle & E.B. Saff, *Fundamentals of Differential Equations and Boundary Value Problems*, Addison-Wesley, 1996.
2. R.L. Borrelli & C.S. Coleman, *Differential Equations*, Wiley, 1998.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

### **SJES2436 - COMPUTATIONAL METHODS II (3 CREDITS)**

**Prerequisite: SJES2234 or SJES1215**

Solution of Linear System of Equations, Gaussian elimination method, Pivoting Strategy, Matrix factorization, Vector and matrix norms, Error bounds, residual correction method, iterative methods. Eigenvalues & eigenvectors, power method, Sturm sequence, householder method, QR method. Numerical solution of ODE, Euler's method, higher order Taylor's method, Runge-Kutta method, multistep methods, system of ODE.

References:

1. K.E. Atkinson, *Elementary Numerical Analysis*, 2<sup>nd</sup> ed., Wiley, 1993.
2. R.L. Burden & J.D. Faires, *Numerical Analysis*, 7<sup>th</sup> ed., Brooks/Cole, 2001.

Assessment:

Continuous Assessment: 30%  
Final Examination: 70%

### **SJES2438 - MANAGEMENT MATHEMATICS (3 CREDITS)**

**Prerequisite: SJES1221**

Output function: Theory and some concepts. Break even model. Optimization profit. Monopoly and oligopoly. Inventory control: EOQ Model, reordering point, finite input rate, shortage and quantity discount. Probabilistic Model, safe stock, efficiency level. Decision under certainty and uncertainty.

References:

1. J. Baldani, J. Bradfield & R. Turner, *Mathematical Economics*, The Dryden Press, 1996.
2. R.A. Barnett & M.R. Ziegler, *Applied Calculus for Business, Economics, Life Sciences and Social Sciences*, 4<sup>th</sup> ed., Dellen Publishing Company, 1991.
3. K.R. Davies, P.G. McKeown & T.R. Rakes, *Management Science: An Introduction*, Kent Publishing Company, 1986.
4. W.L. Winston, *Operations Research: applications and algorithms*, 3<sup>rd</sup> ed., Duxbury Press, 1994.
5. M. Wisniewski, *Introductory Mathematical Methods in Economics*, McGraw-Hill Book Company, 1991.

Assessment:

Continuous Assessment:	40%
Peperiksaan Akhir:	60%

**SJES2439 - LINEAR PROGRAMMING  
(3 CREDITS)**

**Prerequisite: SJES1221**

Formulation of linear programming models / problems, MPL. Graphical solution. Graphical solution. Primal simplex method. M-large, two-phase, dual simplex. MPL primal and dual. Matrix operation and sensitivity analysis. Transportation model and mapping.

References:

1. Nordin Hj. Mohamad, *Pengaturcaraan Linear: algoritma simpleks asas pengurusan kuantitatif*, Cetakan Pertama, NHM-ISM, Kuala Lumpur, 2001
2. B.D. Bunday, *Basic Linear Programming*, Edward Arnold, (edisi Bahasa Malaysia oleh DBP), 1984.
3. R.E. Markland, *Topics in Management Science*, 3<sup>rd</sup> ed., John Wiley & Sons, 1989.
4. L.J. Moore, S.M. Lee & B.W. Taylor, *Management Science*, 4<sup>th</sup> ed., Allyn and Bacon, 1993.
5. H.A. Taha, *Operations Research: An Introduction*, 5<sup>th</sup> ed., Macmillan Publishing Company (edisi Bahasa Malaysia oleh USM-DBP), 1992.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2440 - TECHNIQUES OF OPTIMIZATION  
(3 CREDITS)**

**Prerequisite: SJES1221**

Single-variable unconstrained optimization - direct methods and approximation methods - use of polynomials. Multivariable unconstrained optimization- direct methods and methods using gradients. Constrained optimization - classical approach - Kuhn Tucker Theory-use of simplex algorithm for linear programming.

References:

1. M. Bazaraa & C. Sketty, *Nonlinear Programming: Theory and Algorithms*, John Wiley, New York, 1979.
2. C. Beightler, D.T. Phillips & D.J. Wilde, *Foundations of optimization*, 2<sup>nd</sup> ed., Prentice Hall, New Jersey, 1979.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2441 - COMPUTER GRAPHICS  
(3 CREDITS)**

**Prerequisite: SJES2271**

Introduction to MS Visual C++ Compiler and Open GL. Mathematics for 2 and 3-Dimensional Computer Graphics. Coordinate transformations: 2D transformations, 2D viewing transformations, 3D viewing transformation, orthographic and perspective projections. Polynomial interpolation: Linear interpolation, Aitken's interpolation, Lagrange polynomial, cubic Hermite, Bernstein polynomials, Continuity. Curve and surface design.

References:

1. I.D. Faux, I.D. & M.J. Pratt, *Geometri Pengiraan untuk Rekabentuk dan Perkilangan*, Ellis Horwood Ltd. 1980 (Terjemahan oleh Hassan Said, Dewan Bahasa & Pustaka, 1990).
2. D.F. Rogers & J.A. Adams, *Mathematical Elements for Computer Graphics*, 2<sup>nd</sup> ed., McGraw Hill International Editions, 1990.
3. Donald Hearn, M. Pauline Baker, *Computer Graphics*, Prentice Hall.
4. Computer Graphics, *Scaum's Outline*.

Assessment:

Continuous Assessment:	50%
Final Examination:	50%

**SJES2442 - ARTIFICIAL INTELLIGENCE  
(3 CREDITS)**

**Prerequisite: SJES2271**

Introduction to Artificial Intelligence (AI). Fundamental Concepts in AI, search space, search techniques. Heuristics. Introduction to Genetic Algorithm. Simple Genetic Algorithm. Application of Genetic Algorithm in Optimization Problems.

References:

1. D.E. Goldberg, *Genetic Algorithms in search, Optimization and Machine Learning*, Addison-Wesley Publishing Company Inc., 1989.
2. Z. Michalewicz, *Genetic Algorithms + Data Structures = Evolution Programmes*, Springer-Verlag, 1992.

Assessment:

Continuous Assessment:	50%
Final Examination:	50%

**SJES2443 - ENGINEERING MATHEMATICAL METHODS II (3 CREDITS)**

**Prerequisite: SJES2223**

Functions of a complex variable, Fourier Series, Laplace and Fourier Transforms, Orthogonal Functions and Partial Differential Equations.

References:

1. E. Kreyszig, *Advanced Engineering Mathematics*, 9<sup>th</sup> Edition, John Wiley & Sons, 2006
2. E. Butkov, *Mathematical Physics*, Addison-Wesley, 1966.
3. R.k. Nagle & E.B. Staff, *Fundamentals of Differential Equations and Boundary Value Problems*, 2<sup>nd</sup> Edition, Addison-Wesley, 1996.
4. W.E. Boyce & R.C. DiPrima, *Elementary Differential Equations and Boundary Value Problems*, 8<sup>th</sup> Edition, John Wiley & Sons, 2005.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2450 - STOCHASTIC PROCESSES (3 CREDITS)**

**Prerequisite: SJES2250**

Simple random walk on the integers and its properties. Its relation to Markov chains. Discrete time Markov Chains-classification of states-properties of chains and limiting and stationary probabilities.

References:

1. H.M. Taylor and S. Karlin, *An introduction to stochastic modeling*, Academic Press, 1994.
2. S. Karlin & H.M. Taylor, *A first course in stochastic processes*, 2<sup>nd</sup> ed., Academic Press, 1975.
3. S.M. Ross, *Introduction to probability models*, 7<sup>th</sup> ed. Harcourt (Academic Press) 2000.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2462 - NONPARAMETRIC STATISTICS (3 CREDITS)**

**Prerequisite: SXEX1102 or SJES 1250**

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.

Reference:

1. W.W. Daniel, *Applied Nonparametric Statistics*, 2<sup>nd</sup> ed., PWS-Kent, 1990.
2. J.D.Gibbons, *Nonparametric Methods for Quantitative Analysis*, American Science Press, Columbus, 1985.
3. W.J. Conover, *Practical Nonparametric Statistics*, Wiley, 1980.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2463 - REGRESSION ANALYSIS (4 CREDITS)**

**Prerequisite: SXEX1102**

Outlier. Transformation. Graphical Representations of univariate and multivariate data. Rankit plot. Quantile plot. Symmetric plot. "Back-to-back" stem-and-leaf plot. Quantile-quantile plot. Strip plot. Categorical data. Comparison of two groups of numbers. Regression. Comparison of more than two groups of numbers. One-way and two-way analysis of variance. Report writing.

References:

1. S. Weisberg, *Applied Linear Regression*, 2<sup>nd</sup> ed., Wiley, 1985.
2. B. L. Bowerman & R.T. O'Connell, *Linear Statistical Models*, 2<sup>nd</sup> ed., PWS-Kent, 1990.
3. Myers, R.H. & J.S. Miltors, *A First Course in the Theory of Linear Statistical Models*, PWS-Kent, 1991.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES2466 - INTRODUCTORY LIFE CONTINGENCY (3 CREDITS)**

**Prerequisite: SJES2250**

Survival distributions and life tables, life assurances, life annuities, commutation functions for assurances and annuities, Continuous assurances and annuities, Increasing assurances and annuities.

References:

1. Nesbitt, Cecil, Jones, Hickman, Gerber, Bowers, *Actuarial Mathematics*, 2nd ed., Soc. Actuaries, 1997.
2. Neil, A., *Life Contingencies*: London, 1997.
3. Robert W. Batten, *Life Contingencies*, Heinemann: London, 1977.
4. Jordan, Chester Wallace, *Society of Actuaries Textbook on Life Contingencies*, The Society of Actuarial, 1975.
5. Cunningham Robin J., Henzog Thomas N., and Landon Richard L., *Models for Quantifying Risk*, ACTEX Publication, Inc, 2005.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJEP3360 – EDUCATIONAL STATISTICS  
(3 CREDITS)**

**Prerequisite: SJES2250**

This course is very much relevant to students who are engaged or plan to do research in education or social science. This course is divided into two main parts. First part is on measurements including reliability and validity. Types or reliabilities and methods of computing them are introduced as well as item analysis of a test. Will also discuss the concept and application of partial and multiple correlation. The second part will emphasize on the statistical techniques that are normally used in education : assumption, purpose of statistical test, advantages and disadvantages of the techniques used in analysing data. Course content: Reliability, validity , item analysis, partial and semi partial correlations, simple and multiple regressions, component analysis.

References:

1. D. Kleinbaum & L. Kupper, *Applied regression analysis and other multivariate methods*, Duxbury Press, 1988.
2. F.N. Kerlinger & E.J. Pedhazur, *Multiple regression in behavioral research*, 2<sup>nd</sup> ed., Holt, Rinehart, Winston, 1973.
3. F.G. Brown, *Principles of educational and psychological testing*, 3<sup>rd</sup> ed., Holt, Rinehart, Winston, 1970.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES3411 - GRAPH THEORY (3 CREDITS)**

**Prerequisite: SJES2411**

Graph theory and its applications. Selected topics on Eulerian graphs, trees, planar graphs, graph colouring and chromatic polynomials, Hamiltonian graphs, matching theory, directed graphs and the shortest path problem, network theory.

References:

1. J.A. Bondy & U.S.R. Murty, *Graph Theory with Applications*, The Macmillan Press, 1976.
2. G. Chartrand & L. Lesniak, *Graphs and Digraphs*, 3<sup>rd</sup> ed., Chapman and Hall, New York, 1996.
3. R.J. Wilson & J.L. Watkins, *Graphs – An Introductory Approach*, John Wiley & Sons, 1990.

Assessment:

Continuous Assessment:	30%
Final Examination:	70%

**SJES3412 - COMBINATORIAL MATHEMATICS  
(3 CREDITS)**

**Prerequisite: SJES2411**

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.

References:

1. R. A. Brualdi, *Introductory Combinatorics*, North Holland Publ. Co., 1977.
2. C. C. Chen & K.M. Koh, *Principles and Techniques in Combinatorics*, World Scientific, 1992.
3. C. L. Liu, *Introduction to Combinatorial Mathematics*, Computer Science Series, McGraw Hill Book Co., 1968.
4. A.P. Street and W.D. Wallis, *Combinatorial Theory: An Introduction*, The Charles Babbage Research Center, Manitoba, Canada, 1977.
5. A. Tucker, *Applied Combinatorics*, John Wiley and Sons, New York, 1980.

Assessment:

Continuous Assessment:	30%
Final Examination:	70%

**SJES3413 - NUMBER THEORY (3 CREDITS)**

**Prerequisite: SJES1215**

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.

References:

1. D. Burton, *Elementary Number Theory*, 5<sup>th</sup> ed., McGraw Hill Pub. Co., 2002.
2. K.H. Rosen, *Elementary Number Theory and its applications*, 5<sup>th</sup> ed., Addison Wesley Longman, Inc., 2004.
3. J.K Strayer, *Elementary Number Theory*, 1<sup>st</sup> ed., PWS Pub. Co., 1994.

Assessment:

Continuous Assessment:	30%
Final Examination:	70%

**SJES3414 - LINEAR ALGEBRA III (3 CREDITS)**

**Prerequisite: SJES2215**

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. Triangulation theorem, primary decomposition theorem, Jordan canonical forms.

References:

1. J. Broida & G. Williamson, *A Comprehensive Introduction to Linear Algebra*, Addison-Wesley Publ. Co., 1989.
2. J.B. Fraleigh & R.A. Beauregard, *Linear Algebra*, 3<sup>rd</sup> ed., Addison-Wesley, 1995.
3. S.B. Friedberg, A.J. Insel & L.E. Spence, *Linear Algebra*, 2<sup>nd</sup> ed., Prentice Hall 1989.
4. Jin Ho Kwak, Sungpyo Hong, *Linear Algebra*, 2<sup>nd</sup> ed., Birkhauser, 2004.

Assessment:

Continuous Assessment: 30%  
Final Examination: 70%

**SJES3415 - MATRIX THEORY (3 CREDITS)**

**Prerequisite: SJES2215**

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

References:

1. R.B. Bapat, *Linear Algebra and Linear Models*, 2<sup>nd</sup> ed., Springer, 2000.
2. F.A. Graybill, *Matrices with Applications to Statistics*, 2<sup>nd</sup> ed., Wardworth, 1983.
3. R. A. Horn & C. R. Johnson, *Matrix Analysis*, Cambridge University Press, 1985.
4. B. Noble & I.W. Daniel, *Applied Linear Algebra and its Applications*, 3<sup>rd</sup> ed., Prentice Hall, 1988.
5. S.R. Searle, *Matrix Algebra useful for Statistics*, John Wiley & Sons, Inc., 1982.

Assessment:

Continuous Assessment: 30%  
Final Examination: 70%

**SJES3416 - ALGEBRA II (3 CREDITS)**

**Prerequisite: SJES2216**

Groups – Isomorphism Theorems. Permutation groups. Group Actions, p-groups.  
Rings – Maximal and prime ideals, Polynomial rings. Field extensions. Finite fields.

References:

1. J.R. Durbin, *Modern Algebra, An Introduction*, 2<sup>nd</sup> ed., John Wiley, 1985.
2. J.B. Fraleigh, *A First Course in Abstract Algebra*, 5<sup>th</sup> ed., Addison-Wesley, 1994.
3. I.N. Herstein, *Abstract Algebra*, 2<sup>nd</sup> ed., Macmillan, 1990.

Assessment:

Continuous Assessment: 30%  
Final Examination: 70%

**SJES3417 - RING THEORY (3 CREDITS)**

**Prerequisite: SJES2216**

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.

References:

1. D. M. Burton, *A First Course in Rings and Ideals*, Addison-Wesley Publ. Co., 1970.
2. I.N. Herstein, *Noncommutative Rings*, Carus Mathematical Monographs No. 15, Math. Assoc. of America, 1968.
3. J. A. Beachy, *Introductory Lectures on Rings and Modules*, London Maths. Soc. Student Texts 47, Cambridge University Press, 1999.

Assessment:

Continuous Assessment: 30%  
Final Examination: 70%

**SJES3418 - GROUP THEORY (3 CREDITS)**

**Prerequisite: SJES2216**

Cyclic groups. Direct product of groups. Finite and finitely generated abelian groups. Soluble groups, Nilpotent groups

References:

1. W. Lederman, *Introduction to the Theory of Finite Groups*, Longman, Oliver & Boyd, 1973.
2. Joseph J. Rotman, *The Theory of Finite Groups*, Allyn and Bacon, 1973.

Assessment:

Continuous Assessment: 30%  
Final Examination: 70%

**SJES3419 - GROUP THEORETICAL METHODS  
(3 CREDITS)**

**Prerequisite: SJES2215 or SJES2216**

Group, Examples of finite and continuous group, group generator, conjugacy class, subgroup, group representation, irreducibility, Schur Lemma, character, direct product for two representations, Introduction to Lie group, Group SO(3) and SU(2), irreducible representation, application to quantum system.

References:

1. J.P. Elliot and P.G. Dawbar, *Symmetry in Physics: Principles and Simple Applications*, The Macmillan Press, 1985.
2. W.K. Tung, *Group Theory in Physics*, World Scientific, 1985.

Assessment:

Continuous Assessment: 30%  
Final Examination: 70%

**SJES3421 - DIFFERENTIAL GEOMETRY  
(3 CREDITS)**

**Prerequisite: SJES2223**

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.

References:

1. Zul Kepli Mohd. Desa. *Pengenalan Geometri Kebezaan*. Dewan Bahasa dan Pustaka, 1994.
2. R.S. Millman and G.D. Parker. *Elements of Differential Geometry*. Prentice Hall.
3. M.M. Lipschutz. *Differential Geometry*. Schaum's Outline Series, McGraw Hill Book Co.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3422 - TOPOLOGY (3 CREDITS)**

**Prerequisite: SJES2223**

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

References:

1. W. J. Pervin, *Foundations of General Topology*, Academic Press, 1974.
2. Seymour Lipschutz, *General Topology*, Schaum's Outline Series, 1965.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3423 - MEASURE AND INTEGRATION  
(3 CREDITS)**

**Prerequisite: SJES2224**

Measure spaces. Integration. Properties of convergence. Lebesgue measure. Relation between Riemann and Lebesgue integrals. Product measure, multiple integral and iterated integral. Minkowski's and Holder's inequalities.  $L^p$  spaces.

References:

1. R.G. Bartle, *The Element of Integration*, 2<sup>nd</sup> ed., John Wiley & Sons, 1976.
2. H.L. Royden, *Real Analysis*, Macmillan, 1968.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3424 - MULTIVARIABLE ANALYSIS  
(3 CREDITS)**

**Prerequisite: SJES2223 or SJES2224**

Vector valued function. Linear functions. Derivative. Partial and directional derivatives. Composite functions. Mean Value Theorem. Taylor's theorem. Equality of mixed partial derivatives. Fixed point theorem and its application. Inverse function theorem and implicit function theorem.

References:

1. R.G. Bartle, *The Element of Real Analysis*, 2<sup>nd</sup> ed., John Wiley & Sons, 1992.
2. H. Cartan, *Differential Calculus*, Herman, 1971.
3. S. Lang, *Undergraduate Analysis*, Springer Verlag, 1983.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3425 - COMPLEX ANALYSIS (3 CREDITS)**

**Prerequisite: SJES2425**

Zeros and singularities. Applications of residue calculus. Arguments Principle. Rouche's Theorem. Maximum modulus principle. Infinite Products. Poisson Integral. Entire Functions. Jensen's Theorem. Weierstrass Factorization Theorem. Hadamard's Theorem. Introduction to Conformal Mapping.

#### References

1. John H. Mathews and Russel W. Howell, *Complex Analysis: for Mathematics and Engineering*, 5<sup>th</sup> ed. 2006, Jones and Bartlett Pub. Inc.
2. A David Wunsch, *Complex Variables with Applications*, 3<sup>rd</sup> ed. 2005 Pearson Addison Wesley.
3. E. B. Saff and A. D. Snider, *Fundamental Complex Analysis with Application to Engineering and Science*, 3<sup>rd</sup> ed. 2003 Pearson Prentice Hall International Ed.
4. A.S.B. Holland, *Introduction to the theory of entire functions*, Academic Press, 1973.
5. A.I. Markushevich, *Theory of functions of a complex variable*, Chelsea Publ. Co. 1985.

#### Assessment:

Continuous Assessment: 30%  
Final Examination: 70%

#### **SJES3426 - REAL ANALYSIS (3 CREDITS)**

##### **Prerequisite: SJES2224**

Derivative of a real function. Rules of differentiation. Chain rule. Rolle Theorem, Mean Value Theorem. Properties of the derivative. L'Hopital Rule, Inverse Function Theorem. Infinite series. Test of convergence. Absolute and conditional convergence. Rearrangement of series. Power series, Taylor's Theorem. Riemann Integral. Integrability conditions, properties of the integral. Improper integrals. Sequence and series of functions. Pointwise convergence, uniform convergence. Results on uniform convergence.

#### References:

1. W. A. J. Kosmala, *A Friendly Introduction to Analysis*, 2<sup>nd</sup> Ed. Pearson Education International, 2004.
2. Edward D. Gaughan, *Introduction to Analysis*, 5<sup>th</sup> ed., Brooks/Cole, 1998.
3. R. Haggarty, *Fundamentals of Mathematical Analysis*. 2<sup>nd</sup> ed., Addison-Wesley Publ. Co., 1993
4. Rosihan Mohamed Ali & Ong Boon Hua, *Pengantar Analisis*, Edisi Pertama, Penerbit Universiti Sains Malaysia, 1999.
5. R.G. Bartle & D.R. Sherbert, *Introduction to Real Analysis* 2<sup>nd</sup> ed., John Wiley & Sons Inc., 1992.

#### Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

#### **SJES3429 - INTERPOLATION AND POLYNOMIAL APPROXIMATION (3 CREDITS)**

##### **Prerequisite: SJES2223**

Polynomial Interpolation: Taylor's polynomial and the convergence of Taylor's series. Lagrange and Newton interpolation formula. Chebyshev polynomial, Hermite interpolation. Error analysis. Spline interpolation: Cubic spline, B-splines. Polynomial approximation: Weierstrass theorem,

monotone operators, Bernstein operator. Minimax approximation. Least square approximation.

#### References:

1. P.J. Davis, *Interpolation and Approximation*, Dover Publ., 1975.
2. M.J.D. Powell, *Approximation Theory and Methods*, Cambridge University Press, 1991.
3. G.M. Phillips & P.J. Taylor, *Theory and Applications of Numerical Analysis*, Academic Press, 1996.

#### Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

#### **SJES3431 - INTRODUCTION TO QUANTUM MECHANICS WITH COMPUTER (3 CREDITS)**

##### **Prerequisite: SJES2271**

Introduction to quantum mechanics. Wave functions and their interpretations. One dimensional time independent Schrödinger's equation. Solution for the case 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.

#### References:

1. David J. Griffiths, *Introduction to Quantum Mechanics*, Prentice-Hall, 1995.
2. David K. Ferry, *Quantum Mechanics: An introduction for device physicists and electrical engineers*, 2<sup>nd</sup> ed., Institute of Physics Publ., 2001.
3. Rubin Landau & Manuel Paez, *Computational Physics: Problem solving with computers*, John Wiley, 1997.
4. Robert Scherrer, *Quantum Mechanics: An Accessible Introduction*, Pearson Education, 2006.

#### Assessment:

Continuous Assessment: 50%  
Final Examination: 50%

#### **SJES3432 – CRYPTOGRAPHY (3 CREDITS)**

##### **Prerequisite: SJES2271 dan SJES2250**

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.

#### References:

1. Trappe, W., and Washington, L. C., *Introduction to Cryptography with Coding Theory*, 2<sup>nd</sup> edition, Pearson Prentice Hall, 2006.
2. Stallings, W., *Cryptography and Network Security:- Principles and Practice*, 4<sup>th</sup> edition, Englewood Cliffs (NJ): Prentice Hall, 2006.

- Schneier, B. , Applied Cryptography, 2<sup>nd</sup> edition, New York: John Wiley and Sons, 1996.
- Denning, D. E., Cryptography and Data Security, Addison Wesley, 1982.
- Stinson, D. R., Cryptography: Theory and Practice, CRC Press, 1995.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES3435 - COMPUTATIONAL FLUID DYNAMICS (3 CREDITS)**

**Prerequisite: SJES2434**

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.

References:

- S.M. Richardson, Fluid Mechanics, Hemisphere Pub. Corp., 1989.
- J.A. Liggett, Fluid Mechanics, McGraw-Hill, 1994

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES3436 - COMPUTATIONAL METHODS III (3 CREDITS)**

**Pre-requisite: SJES2436**

Approximation of Functions: Discrete and continuous least squares approximation, orthogonal polynomials, rational function approximation, Hermite interpolation. Further integration. Gaussian quadrature. Improper integrals. Nonlinear system of equations, fixed point iteration, Newton method, quasi-Newton method, Steepest descent techniques. Boundary value problems for ordinary differential equations, shooting method, finite difference method.

References:

R.L. Burden & J.D. Faires, *Numerical Analysis*, 7<sup>th</sup>ed., Brooks/Cole, USA, 2001.

Assessment:

Continuous Assessment:	30%
Final Examination:	70%

**SJES3437 - MATHEMATICAL MODELING II (3 CREDITS)**

**Prerequisite: SJES2435 or SJES2235**

Studying the existing mathematical models such as the prey-predator, chemical reactions and physiology of the heart analytically. Stability of linear and non linear systems.

References:

- R.K. Nagle & E.B. Saff, *Fundamentals of Differential Equations and Boundary Value Problems*, Addison-Wesley, 1996.
- R.L. Borelli & C.S. Coleman, *Differential Equations*, Wiley, 1998.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES3439 - PRODUCTION AND INVENTORY CONTROL (3 CREDITS)**

**Prerequisite: SJES2438 or SJES2439**

The importance to inventory in management. Advanced economic ordering 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. Supply control and network inventory.

References:

- Hamdy A. Taha, *An Introduction to Operational Research*.
- E. Naddor, *Inventory Systems*.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES3441 - GAME THEORY (3 CREDITS)**

**Prerequisite: SJES2236**

Two-Person Zero-sum Games: Strategic and extensive form. Two person general sum games: cooperative and Non cooperative. Games in Coalitional Form: Imputations, core, Shapley Value and the nucleolus.

References:

- G. Owen, *Game Theory, Second Edition*.
- J.C.C McKinsey, *Introduction to the Theory of Game*.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES3443 - ADVANCED LINEAR PROGRAMMING (3 CREDITS)**

**Prerequisite: SJES2439**

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-Wolfe decomposition principle. Pure, mixed and binary (0-1) integer programming. Cutting plane, and branch and bound methods. Multi-objectives linear goal programming. Graphical. Simplex iterative and modified methods.

References:

1. H. A. Taha, Operation Research: An Introduction. 5<sup>th</sup> edition. Macmillan Pub. Co. (edisi Bahasa Malaysia oleh USM-DBP, 1992).
2. F. S. Hillier & M. S. Hillier, Introduction to Management Science. 2<sup>nd</sup> edition. McGraw-Hill International Edition, 2004.
3. W. L. Winston, Operations Research, Application and Algorithms. Duxbury Press, 1994.
4. M. S. Bazaraa, J. J. Jarvis & H.D. Sherali, Linear Programming and Network Flows. John Wiley & Sons, 1990.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3444 - NETWORK FLOW ANALYSIS (3 CREDITS)**

**Prerequisite: SJES2439**

Definition of a network. Node, branch and path. Shortest path, decision tree and maximum flow. Critical path model method. Project valuation. Optimal path. Project scheduling. Network model as an example of a linear programming model.

References:

1. D.F. Groebner & P.W. Shannon, *Introduction to Management Science*, International Editions, Dallen-Macmillan-Maxwell, 1991.
2. L.L. Lipin, *Quantitative Methods for Business Decisions (with cases)*, 6<sup>th</sup> ed., Dryden Press, 1994.
3. R. E. Markland & J.R. Sweigart, *Quantitative Methods: Applications to Managerial Decision Making*, John Wiley & Sons, 1987.
4. B. W. Taylor, *Introduction to Management Science*, Allyn and Bacon, 1993.
5. W. L. Winston, *Operations Research: Applications and Algorithms*, 3<sup>rd</sup> ed., Duxbury Press, 1994.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3446 - DYNAMIC PROGRAMMING (3 CREDITS)**

**Prerequisite: SJES2236**

Permutations, Self Maps, Integer Factorizations. Graphs and Digraphs, Integer Linear Forms. Relational Setsystems for Abelian Groups and Fields

References:

1. G. Hadley, *Nonlinear and Dynamic Programming*
2. G.L. Nemhauser, *Introduction to Dynamic Programming*.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3447 - COMPUTATIONAL GEOMETRY (3 CREDITS)**

**Prerequisite: SJES2441**

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

References:

1. G. Farin, *Curves and Surfaces for Computer Aided Geometric Design*, Academic Press Inc., 1988.
2. M.E. Mortenson, *Geometric Modelling*, Wiley, 1985.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3450 - APPLIED STOCHASTIC PROCESSES (3 CREDITS)**

**Prerequisite: SJES2450 or SJES1231**

Fundamental matrix. Time reversible Markov chains. Poisson processes. Birth and death processes. Random walk and Brownian motion. Application to real-world phenomena and finance.

References:

1. H.M. Taylor and S. Karlin, *An introduction to stochastic modeling*, Academic Press, 1995.
2. E.P.C. Kao, *An introduction to stochastic processes*, Duxbury Press, 1997.
3. S.M. Ross, *An introduction to probability models*, 7<sup>th</sup> ed., Harcourt Academic Press, 2000.
4. S.M. Ross, *Stochastic processes*, 2<sup>nd</sup> ed., John Wiley, 1996.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3451 - INFORMATION PROCESSING AND THEORY OF STATISTICAL COMMUNICATION (3 CREDITS)**

**Prerequisite: SJES2250**

Communication system model. Information measures. Entropy function. Stationary process. Stationary ergodic process. Statistical information in natural languages. Shannon -McMillan Theorem. Asymptotic Equipartition' Principle. Estimation of entropy rate. Source coding theorem for constant length code and variable length code. Huffman code. Discrete memoryless channel. Evaluation of channel capacity. Fundamental theorem for communication channel. Error correcting codes for communication channel.

References:

- 1 R.G. Gallager, *Information Theory and Reliable Communication*, Wiley, 1968.
- 2 T. M. Cover & J.A. Thomas, *Elements of Information Theory*, Wiley, 1991.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3452 - INTRODUCTION TO RELIABILITY THEORY (3 CREDITS)**

**Prerequisite: SJES2250**

Failure and hazard rates. Mean life residue. Stochastic modelling for complex systems. Maintenance policies. Repetition. Multiple components structure.

References:

1. Euring Michael Beasley, *Reliability for Engineers: An Introduction*, Macmillan.
2. Ernest J. Henley & Hiromitsu Kumamoto, *Reliability Engineering and Risk Assessment*, Prentice-Hall.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3453 - MONTE CARLO SIMULATION METHODS (3 CREDITS)**

**Prerequisite: SJES2250**

Concept of Monte Carlo method, Monte Carlo approximation of integrals, generation of pseudo random variates from uniform and non-uniform random variables; general methods: inverse transform, rejection method, composition method; applications to statistical procedures, estimating p-values, variance reduction; bootstrap, basics of Monte Carlo Markov chain.

References:

1. S.M. Ross, *A Course in Simulation*, Maxwell-Macmillan, 1991.
2. B.J.T. Morgan, *Elements of Simulation*, Chapman & Hall, 1984.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3454 - INTRODUCTORY MULTIVARIATE ANALYSIS (3 CREDITS)**

**Prerequisite: SJES2250**

The use / application of Multivariate analysis. Managing and Handling Multivariate data. Matrix theory. Random vectors and Matrices. The multivariate Normal Distribution, the Wishart distribution and the Hotellings distribution. Selected topics from; Graphical methods, Regression Analysis, Correlation, Principle Components, Factor Analysis, Discriminant analysis and Clustering Methods

References:

1. K.A. Johnson & D.W. Wichern, *Applied Multivariate Analysis*, 5<sup>th</sup> ed., Prentice- Hall International, 2002.
2. C. Chatfield & A.J. Collins, *An Introduction to Multivariate Analysis*, Chapman & Hall, 1980.
3. T.A. Anderson, *An Introduction to Multivariate Statistical Analysis*, 2<sup>nd</sup> ed., Wiley, 1984.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3455 - FURTHER MATHEMATICAL STATISTICS (3 CREDITS)**

**Prerequisite: SJES2251**

Sufficient and complete statistics. Minimum variance unbiased estimators. Sufficient statistics and best estimators. Distributions of special quadratic forms. One and two factors analysis of variance. Simple regression theory and inference of parameters. Correlation analysis in bivariate normal distribution. Multiple regression and normal equations. Sequential probability ratio test.

References:

1. R.V. Hogg & A.T. Craig, *Introduction to Mathematical Statistics*, 5<sup>th</sup> ed., Wiley, 1995.
2. R.V. Hogg & E.A. Tanis, *Probability and Statistical Inference*, 5<sup>th</sup> ed., 1997, MacMillan.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

### **SJES3456 – INTRODUCTION TO SURVIVAL ANALYSIS (3 CREDITS)**

**Prerequisite: SJES2251**

Parametric estimation of life function; maximum likelihood estimate, moment estimate, Bayesian estimate; Non-parametric estimation for life function, Kaplan-Meier estimate and Nelson-Aalen estimate; Proportional hazard model, estimation of hazard function and survival function.

#### References:

1. Miller, Rupert G., Survival Analysis, John Wiley, 1981.
2. London, Dick, Survival Models and their Estimation. ACTEX Publications, 1998.
3. Collett, D., Modelling Survival Data in Medical Research, Chapman & Hall/CRC, 2003.
4. Lawless, J. F. (Jerald F.), Statistical Models and Methods for Lifetime Data, Wiley-Interscience, 2003.
5. Smith, Peter J., Analysis of Failure and Survival data, Chapman & Hall/CRC, 2002.

#### Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

### **SJES3460 - DESIGN AND ANALYSIS OF EXPERIMENTS (3 CREDITS)**

**Prerequisite: SJES2251**

Philosophy related to statistical designed experiments. Completely randomized one-factor design. Randomized block designs. Latin squares. Incomplete block designs. Factorial designs. Confounding. Fractional factorial designs.

#### References:

1. Montgomery, D. C.: Design and Analysis of Experiments. 6<sup>th</sup> edition, John Wiley, 2005.
2. Box, G.E.P., Hunter, W.G. and Hunter, J.S.: Statistics for Experimenters. 2<sup>nd</sup> edition, John Wiley, 2005.

#### Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

### **SJES3462 - INTRODUCTION TO SURVEY SAMPLING (3 CREDITS)**

**Prerequisite: SJES2250**

Simple random sampling. Parameter estimation in subpopulation. Stratified Random Sampling. Ratio estimation. Regression estimation. Cluster sampling. Systematic sampling. Two-stage sampling.

#### References:

1. R.L. Scheaffer, Elementary Survey sampling, 4<sup>th</sup> ed., PWS-Kent, 1990.
2. S.K. Thompson, Sampling, Wiley, 1992.
3. W. Cochran, Sampling Techniques, 3<sup>rd</sup> ed., Wiley, 1977.

#### Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

### **SJES3463 - STATISTICAL PROCESS CONTROL (3 CREDITS)**

**Prerequisite: SJES2250**

Methods and philosophy of statistical process control. Control charts for variables and attributes. CUSUM and EWMA charts. Process capability analysis. Acceptance sampling, rectifying inspection. Lot-by-lot acceptance sampling by attributes. Acceptance sampling by variables.

#### References:

1. D.C. Montgomery, *Introduction to Statistical Quality Control*, 2<sup>nd</sup> ed., Wiley, 1991.
2. G. Taguchi, *Introduction to Quality Engineering: Designing Quality into Products and Processes*, Tokyo: Asian Productivity Organization, 1986.

#### Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

### **SJES3466 - FURTHER LIFE CONTINGENCY (3 CREDITS)**

**Prerequisite: SJES2466**

Net premium, gross premium, modelling additional risk, participating policy and bonus gross and net premium policy value multiple life function, multiple decrement model.

#### References:

1. Nesbitt, Cecil, Jones, Hickman, Gerber, Bowers, Actuarial Mathematics, 2nd ed., Soc. Actuaries, 1997.
2. Neil, A., Life Contingencies, Heinemann: London, 1977.
3. Robert W. Batten, Life Contingency and Ruin Theory for the Actuarial Student, Actuarial Bookstore, 1999.
4. Jordan, Chester Wallance, Society of Actuaries Textbook on Life Contingencies, The Society of Actuarial, 1975.
5. Cunningham Robin J., Henzog Thomas N., and Landon Richard L., Models for Quantifying Risk, ACTEX Publications, Inc, 2005.

#### Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3467 - INVESTMENT AND FINANCIAL ANALYSIS I (3 CREDITS)**

**Prerequisite: SJES2251 or SJES2361**

Fixed income securities, Term structure model of interest rates, Binomial interest rate model, Equilibrium short-rate bond price models, The Cox-Ingersoll-Ross model, interest rate derivatives, Markowitz Portfolio Selection model; Equilibrium in capital markets: CAPM and Arbitrage Pricing Theory; performance measurement.

References:

1. Bodie, Z; Kane, A.; and Marcus, A.J., Investments (fifth edition), 2002, McGraw-Hill/Irwin
2. Fabozzi, F.J., The Handbook of Fixed Income Securities (sixth edition), 2001, McGraw-Hill.
3. Hull, J.C., Options, Futures and other Derivatives (fifth edition), 2000, Prentice Hall.
4. Babbel, D. and Merrill, C. Valuation of Interest-Sensitive Financial Instruments, (Second Printing), Frank J. Fabozzi Associates, 1996.
5. H.H. Panjer et al, Financial Economics with Applications to Investments Insurance and Pensions, The Actuarial Foundation, 1998.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3469 - DATA ANALYSIS (3 CREDITS)**

**Prerequisite: SJES2250 or SJES 2463**

Outlier. Data transformation. Graphical representation of univariate and multivariate data. Rankit plot. Quantile plot. Symmetric plot. Strip plot. "Back-to-bak" stem-and-leaf plot. Quantile-quantile plot. Category data. Comparison of two groups of numbers. Regression. Comparison of more than two groups of data. One-way and two-way analysis of variance. Report writing.

References:

1. Ramsey, F. L. and Schafer, D. W., *The statistical sleuth*, Duxbury Press, 1997.
2. Spurrier, J. D. *The practice of statistics: Putting the pieces together*, Duxbury Press, 2000.
3. Noah, D. and Speed, T. *Stat Labs: Mathematical statistics through applications*, Springer-Verlag, 2000.
4. Chatterjee, S., Handcock, M. S. and Simonoff, J. S. , *A casebook for a first course in statistics and data analysis*, Wiley, 1995.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3470 - GENERAL INSURANCE (3 CREDITS)**

**Prerequisite: SJES2251 or SJES2466**

Introduction to insurance and utility theory; types of general insurance products : motor, fire, property and others ,rating factors; data on claims, loss payments and premiums; ingredients of ratemaking: loss development factors, expenses, credibility factors, investment income, projected loss cost per unit exposure, gross rate; calculation of overall average rate change: Loss cost method and loss ratio method, risk classification differentials, balance back.

References:

1. Brown, Robert L., Gottlieb, Leon R., Introduction to Ratemaking and Loss reserving for Property and Casualty Insurance (2nd edition), ACTEX Publications, 2001.
2. Wiser, R.F.; Cookley, J.E.; and Gardner A., Loss Reserving, Foundations of Casualty Actuarial Science (fourth edition), Casualty Actuarial Society, 2001.
3. Bellis et al, Understanding Actuarial Management: The Actuarial Control Cycle, Institute of Actuaries of Australia, 2003.
4. CAS, Foundation of Casualty Actuarial Science (fourth edition), Casualty Actuarial Society, 2001.
5. Lam, Enterprise Risk Management: From Incentives to Controls, John Wiley, 2003.

Assessment:

Continuous Assessment: 40%  
Final Examination: 60%

**SJES3471 - SCIENTIFIC COMPUTING II (3 CREDITS)**

**Prerequisite: SJES 2271**

Functions, arrays, strings, pointers, data structures, file processing. Computation of special functions such as Legendre polynomials, Bessel and Neumann functions. Gaussian quadrature. Numerical solution of systems of linear equations. Introduction to numerical solution of partial differential equations, e.g. heat and wave equations. FTCS, Crank-Nicholson algorithms, etc.

References:

1. John R. Hubbard, *Programming with C++*, 2<sup>nd</sup> ed., McGraw-Hill, 2000.
2. James P. Cohoon and Jack W. Davidson, *C++ program design: an introduction to programming and object-oriented design* , 3<sup>rd</sup> ed., McGraw-Hill, 2002.
3. Harvey Deitel and Paul Deitel, *C++ How to Program*, 4<sup>th</sup> ed., Pearson, 2003.
4. Frank L. Friedman and Elliot B. Koffman, *Problem solving, abstraction and design using C++*, 3<sup>rd</sup> ed., Addison-Wesley, 2000.

5. William H. Press, Saul A. Teukolsky, William T. Vetterling and Brian P. Flannery, *Numerical Recipes in C++: The Art of Scientific Computing*, Cambridge University Press, 2000.

Assessment:

Continuous Assessment:	50%
Final Examination:	50%

**SJES3488 - PROJECT ON MATHEMATICAL SCIENCES (4 CREDITS)**

Refer to the respective lecturers for project synopsis and reference texts.

**SJES3491 - INDUSTRIAL TRAINING (3 CREDITS)**

Candidates are required to spend between two and three months working with selected companies in selected areas of industry.

**SJES4457 - STATISTICAL TIME SERIES (3 CREDITS)**

**Prerequisite: SJES2251**

Deterministic forecasts form time series data. Stationary time series, use of autocorrelation to test stationarity. General ARIMA model, estimation of model parameters, diagnostic checks of the model, forecast, confidence intervals for the forecast

References:

1. Box, G.E.P., Jenkins, G.W., and Reinsel, G. (1994) *Time series analysis, forecasting and control*, 3<sup>rd</sup> ed., Prentice Hall.
2. Fuller, W.A. (1976). *Introduction to statistical time series*. John Wiley.
3. Brockwell, P.J. and Davis, R. A. (1987). *Time series: Theory and methods*. Springer-Verlag.
4. Lutkepohl, Helmut. *Applied Time Series Econometrics*, Cambridge University Press, 2004.
5. Tsay, Ruey S, *Analysis of Financial Time Series*, Wiley, 2002.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES4458 - CREDIBILITY AND RUIN THEORY (3 CREDITS)**

**Prerequisite: SJES2251**

Limited fluctuation and greatest accuracy credibility theory. The Bayesian and credibility premiums. The Buhlmann and Buhlmann-Straub models. Exact credibility. Empirical Bayes parameter estimation. The adjustment coefficient and the Cramer-Lundberg ruin inequality. The maximum aggregate loss and the general solution

References:

1. T. N. Herzog, *Introduction to Credibility Theory* 3<sup>rd</sup> ed, Actex, 1999.
2. S. A Klugman, H. H. Panjer, G. G. Willmot, *Loss Models: From data to decisions*, 2<sup>nd</sup> ed., John Wiley & Sons, 2004.
3. Nesbitt, Cecil, Jones, Hickman, Gerber, Bowers, *Actuarial Mathematics*, 2<sup>nd</sup> ed., Soc. Actuaries, 1997.
4. Daykin, Pentikainenn, Pesonen, *Practical Risk Theory for Actuaries*, Chapman and Hall, 1994.
5. Grandell, Jan, *Aspects of Risk Theory*, Springer-Verlag, 1991.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES4459 – LIFE INSURANCE AND TAKAFUL (3 CREDITS)**

**Prerequisite: SJES2251 or SJES2466**

Types of Insurances products and investment linked Insurance, group Life Insurance, Life Insurance company operation, Underwriting, Claims, Marketing and Sale, Profit testing and product design, Takaful Insurance: Takaful and Syariah Law, Mudharabah and Wakala model, Takaful product design, Regulation : Insurance acts, taxes and role of Bank Negara in Insurance Industry.

References:

1. Insurance Act 1997.
2. Mohd Ma'sum Billah, *Islamic Insurance (Takaful)*, Ilmiah Publisher Sdn, Bhd, 2003.
3. Black, K.J. & Skipper, H.J. 1994. *Life Insurance*. Ed. Ke-12. New Jersey: Prentice-Hall.
4. Mohd Fadzli Yusof, *Mengenal Takaful*, Ibs Buku, 2006.
5. Pengiran Noor Asmawi Pengiran Haji Ahmad. *Takaful: Kepentingan dan Hukum-Hukum Perlaksanaannya*, Dewan Bahasa dan Pustaka Brunei, 2005.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES4465 - INTRODUCTION TO RISK THEORY (3 CREDITS)**

**Prerequisite: SJES2251**

Insurance economics; short term individual risk model; collective risk model for a single period; collective risk model for an extended period; applications of risk theory.

References:

1. Nesbitt, Cecil, Jones, Hickman, Gerber, Bowers, Actuarial Mathematics, 2nd ed., Soc. Actuaries, 1997.
2. Daykin, Pentikainenn, Pesonen, Practical Risk Theory for Actuaries, Chapman and Hall, 1994.
3. Gjessing, Hakon, Present Value Distributions with Applications to Ruin Theory and Stochastic Equations, University of Copenhagen, Laboratory of Actuarial Mathematics, 1997.
4. Batten, Robert and Richard London (Risk Management and Insurance). A Guide for the Actuarial Student: Life Contingencies and Ruin Theory. Winsted, CT: ACTEX Publications, 1999.
5. S.A. Klugman, H.H. Panjer, G.G. Willmot, Loss Models: From Data to Decisions, 2<sup>nd</sup> ed., John Wiley & Sons, 2004.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES4468 - INVESTMENT AND FINANCIAL ANALYSIS II (CREDITS)**

**Prerequisite: SJES3467**

Valuation and application of options; Binomial option pricing techniques, Brownian Motion and Ito's Lemma, Black-Scholes model; Exotic options; Financial risk management, delta-hedging.

References:

1. Bodie, Z; Kane, A.; and Marcus, A.J., Investments (5<sup>th</sup> ed), 2002, McGraw-Hill/Irwin.
2. Fabozzi, F.J., The Handbook of Fixed Income Securities (6<sup>th</sup> ed), 2001, McGraw-Hill.
3. Hull, J.C., Options, Futures and other Derivatives (5<sup>th</sup> ed), 2000, Prentice Hall.
4. Babbel, D. and Merrill, C. Valuation of Interest-Sensitive Financial Instruments, (Second Printing), Frank J. Fabozzi Associates, 1996.
5. Robert, L. M. (2006) Derivatives markets, (2<sup>nd</sup> ed), Addison Wesley.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES4472 – RESERVING, ACCOUNTING AND REINSURANCE FOR PROPERTY AND CASUALTY INSURANCE (3 CREDITS)**

**Prerequisite: SJES2251 or SJES2466**

Definition of reserving terms; paid loss and incurred loss development; loss reserving methods: case reserves, expected loss ratio, chain ladder, average cost per claim and Bornhuetter-Ferguson method, discounting loss reserves; other reserves: unearned premium reserve and additional unexpired risk reserve; insurance accounting principles; types of reinsurance and reserving for reinsurance.

References:

1. Brown, Robert L., Gottlieb, Leon R., Introduction to Ratemaking and Loss reserving for Property and Casualty Insurance (2nd edition), ACTEX Publications, 2001.
2. Wiser, R.F.; Cookley, J.E.; and Gardner A., Loss Reserving, Foundations of Casualty Actuarial Science (fourth edition), Casualty Actuarial Society, 2001.
3. Bellis et al, Understanding Actuarial Management: The Actuarial Control Cycle, Institute of Actuaries of Australia, 2003
4. CAS, Foundation of Casualty Actuarial Science (fourth edition), Casualty Actuarial Society, 2001.
5. Lam, Enterprise Risk Management: From Incentives to Controls, John Wiley, 2003.

Assessment:

Continuous Assessment:	40%
Final Examination:	60%

**SJES4473 – GROUP PRESENTATION ON SELECTED TOPICS RELATED TO ACTUARIALSCIENCE AND FINANCE (3 CREDITS)**

**Prerequisite: SJES2251 or SJES2466**

Practitioner from different areas such as Insurance, Finance and banking, Investment, KLSE and Bank Negara will be invited to give talks. This course is evaluated based on students group presentation on selected topics in actuarial science and finance. Suggested topics are: Life Insurance, General Insurance, Investment Management, KLSE operation, Financial and Banking products, Role of Bank Negara and Corporate taxes.

Assessment:

Continuous Assessment:	100%
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