# Course Specifications for the academic year 2018/2019

## Mathematics Level I - Semester I

MAT111β: Vector Analysis (30 lecture hrs + 15 tutorial hrs)

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|---|---|---|---|---|---|
| **Course Unit number** | MAT111β | **Course Unit Title** | Vector Analysis | | |
| | | **Lectures (hrs.)** | 30 | **Pre-requisites** | None |
| **Credits** | 2 | **Tutorials (hrs.)** | 15 | | |

| | |
|---|---|
| **Course Unit Objectives** | The objectives of this course unit are<br>• to enable the students to use the basic concepts and three fundamental theorems of vector analysis, Gauss', Green's and Stokes' theorems.<br>• to give a sense of usage of the concepts in vector calculus in other fields of the sciences for example, Physics. |
| **Learning Outcomes** | On completion of the course unit, students should be able to<br>• gain a sound knowledge of the basic concepts in vector calculus<br>• apply basic techniques, results and concepts to solve prescribed exercises in the tutorials |
| **Course Content** | **Vector Algebra:** Definition of a Vector, Addition and Subtraction, Components, Physical examples.<br>**Vector Products:** Scalar and Vector products including a brief introduction to determinants, triple products, geometrical applications.<br>Differentiation and Integration of a Vector functions.<br>**Vector Analysis:** Scalar and Vector fields, grad, div, curl, Manipulation with combinations of these operators acting on combinations of fields.<br>**Integral transformations:** Line, Surface and Volume integrals, the divergence theorem, conservative and solenoidal fields, Green's theorem, Stokes theorem.<br>**General coordinates:** Unit vectors in orthogonal curvilinear coordinates, elementary arc length and volume, curl, div, grad in curvilinear coordinates. |
| **Methods of teaching and learning** | Lectures: 30 hrs (2 hrs per week)<br>Tutorial classes: 15 hrs (1 hr per week) |
| **Method of Assessment** | Continuous assessment: 20%<br>End Semester Examination:80% |
| **References** | • M.D. Raisinghania,*Vector Calculus*, S. Chand, 1985.<br>• Bourne, D.E. and Kendall, P.C.,*Vector Analysis*, Oldbourne, 1967.<br>• Absos Ali Shaikh, Sanjib Kumar Jana, *Vector analysis with applications*, Alpha Science, 2009.<br>• Davis, Harry F. *Introduction to Vector Analysis 6th ed*, 1991. |

MAT112δ: Differential Equations (15 lecture hrs + 7 tutorial hrs) -(Credit Value 1.25)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT112δ</td><td>Course Unit Title</td><td colspan="3">Differential Equations</td></tr>
<tr><td>Lectures (hrs.)</td><td>22.5</td><td rowspan="2">Pre-requisites</td><td rowspan="2">GCE(A/L)–Combined Mathematics</td></tr>
<tr><td>Credits</td><td>1.25</td><td>Practical (hrs.)</td><td>0</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit are to provide students<br>• basic knowledge of ordinary differential equations (ODEs) and their solutions analytically<br>• understanding of the behaviour of solutions of ODEs using graphical methods<br>• experience in solving simultaneous ODEs analytically</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">After successfully completing this course unit students will be able to<br>• identify and solve ODEs with different forms<br>• graphically represent the solutions of the ODEs<br>• solve simultaneous differential equations</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">• Classification of differential equations<br>• Solutions of 1st order and 1st degree differential equations,<br>• orthogonal trajectories in Cartesian coordinates,<br>• use of differential operators solving differential equations,<br>• simultaneous differential equations.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures, class discussion, tutorial discussion.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment: 20%<br>End Semester Examination:80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• Mathematics for Engineers, H. K. Dass Dass, H. K. Advanced engineering mathematics. S. Chand Publishing, 2008.<br>• Rai, Bindhyachal, Deba Prosad Choudhury, and Herbert I. Freedman. A course in ordinary differential equations. CRC Press, 2002.</td></tr>
</table>

MAT113δ: Introductory Statistics (15 lecture hrs + 8 tutorial hrs) -(Credit Value 1.25)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT113δ</td><td>Course Unit Title</td><td colspan="4">Introductory Statistics</td></tr>
<tr><td colspan="2">Lectures (Hr)</td><td>15</td><td rowspan="2">Pre-requisites</td><td rowspan="2">A/L Combined Maths</td></tr>
<tr><td>Credits</td><td>1.25</td><td colspan="2">Tutorial (Hr)</td><td>8</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="5">The objective of this course unit is to improve students'<br>• knowledge in the basic concepts of probability and statistics<br>• ability to model day to day life problems using simple statistical models, and<br>• Understanding of how to pursue further study in probability and statistics.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">On completion of the course unit, students should be able to<br>• discuss the fundamentals of probability and various probability rules that measure uncertainty, and<br>• describe the characteristics and compute probabilities using both discrete and continuous probability distributions.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="5">Basic concepts of Probability: Definition of Probability, Conditional Probability and the Independence of events, , The Law of Total Probability and Bayes' Rule, Definition of random variables, Cumulative distribution function, Density functions for discrete random variables and continuous random variables, Expectations, Mean, Variance, standard deviation, Expected value of a function of a random variable, Moments, Central Moments, Moment Generating function.<br>Discrete distributions:Bernoulli and Binomial Distributions, Hypergeometric Distribution, Poisson Distribution, Geometric Distribution.<br>Continuous distributions: Uniform Distribution, Normal Distribution, Exponential and Gamma Distribution.<br>Approximations: Binomial and Poisson by Normal distribution.</td></tr>
<tr><td colspan="7">Method of teaching and learning: Lectures, class discussion, tutorial discussion.</td></tr>
<tr><td colspan="7">Method of Assessment: Continuous assessment: 20%<br>End Semester Examination:80%</td></tr>
<tr><td colspan="7">References:<br>• Wackerly, Dennis, William Mendenhall, and Richard L. Scheaffer. Mathematical statistics with applications. Sixth Edition, Cengage Learning, 2014.<br>• Freund, John E., and Ronald E. Walpole. Mathematical Statistics Englewood Cliffs. (1980).<br>• Sahoo, Prasanna. Probability and mathematical statistics, University of Louisville (2013).</td></tr>
</table>

MAT1142: Mathematics for Biology (30 lecture hrs) Only for students following Biological Science Stream -( Credit Value 2 - Not counted for the Degree)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT1142</td><td>Course Unit Title</td><td colspan="3">Mathematics for Bio Science Students</td></tr>
<tr><td>Lectures (hrs.)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2</td><td>Tutorials (hrs.)</td><td>15</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit are<br>• to introduce basic quantitative techniques needed for Life Sciences.<br>• to convince the students the importance of Mathematics in pursuing higher studies</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to<br>• gain a working knowledge of the basic concepts in Mathematics<br>• apply basic Mathematical techniques to solve problems in relevant subjects</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Numbers(Real, Integers, Natural, Rational, Irrational and Complex) , Elementary Algebra – Indices, Factorials, Functions, exponentials, logarithms, trigonometry, limit of a function, differentiation – first principles, rules for different functions, chain rule, product rule, quotient rule and integration – different techniques, integration by parts, integration using partial fractions, solving differential equations using separation of variables, exact differential equations, elementary probability and statistics</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures: 30 hrs (2 hrs per week)<br>Tutorial classes: 15 hrs (1 hr per week)</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment: 20%<br>End Semester Examination:80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">There is no prescribed book for this course. The students may refer lecture notes and work out exercises therein. Supplementary books are available in the main library for interested students.</td></tr>
</table>

**Mathematics Level I - Semester II**

**MAT121β : Algebra (30 lecture hrs + 15 tutorial hrs) -(Credit Value 2.5)**

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT 121β</td><td>Course Unit Title</td><td colspan="3">Algebra</td></tr>
<tr><td>Lectures +Tutorial Discussions (hrs.)</td><td>45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>3</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">This Course aims to provide students with the knowledge of the principles and properties of elementary set theory, functions, polynomials, determinants; and groups, rings and fields. Students are also expected to gain an appreciation for the applications these basic concept of algebra.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">Upon successful completion of this course, students should be able to perform the following:<ul><li>explain the understanding of principles and concept of elementary sets, functions which include domain and range, operations, compositions, and inverses, determinants, polynomials and groups, rings and fields.</li><li>demonstrate the laws and algebra of sets and properties of sets, functions, polynomials determinants, groups, rings and fields.</li><li>identify the domain and range of functions and outline the procedure for obtaining inverse and composite functions.</li><li>outline the procedure for obtaining roots of polynomials and interpret the relationship between roots and the coefficients of the polynomials.</li><li>apply the concept and principles of sets, functions, determinants, polynomials, groups, rings and fields to solve problems.</li></ul></td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Elementary set theory, relations, mappings and functions, theory of polynomial equations in one variable including the statement of the fundamental theory, Newton's relations between roots, solutions of cubic and biquadratic equations, determinants, solutions of equations using determinants, nth roots of unity, factors of $x^n - a^n$ , $x^n + a^n, x^{2n} - 2x^n a^n \cos(nx) + a^{2n}$, elementary group theory, rings and fields, complex theory approach through fields.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures, class discussion, tutorial discussion.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment -20%<br>End Semester Examination - 80%</td></tr>
</table>

**References**


- Hall, Henry Sinclair, and Samuel Ratcliffe Knight, *Higher algebra*. AITBS Publishers, 2009.
- Herstein, Israel N. *Topics in algebra*. John Wiley & Sons, 2006.
- Bhattacharya, Phani Bhushan, and Surender Kumar Jain. *First course in linear algebra*. New Age International, 1983

MAT122β: Calculus (Real Analysis) (30 lecture hrs + 15 tutorial hrs) -(Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit Number</td><td rowspan="2">MAT122β</td><td colspan="2">Module Title</td><td colspan="2">Real Analysis I (Calculus)</td></tr>
<tr><td>Lecturer (Hrs)<br>Tutorials</td><td>30<br>15</td><td rowspan="2">Prerequisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Practical (Hrs)</td><td>-</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="4">The objectives of this course unit are<br>• to introduce students to the basic ideas of real analysis with the knowledge of elementary logic, real number systems, sequences and limits, continuity and differentiability of functions, and<br>• to develop the theory of real analysis carefully and rigorously from basic principles, giving the student of mathematics the ability to construct, analyze, and critique mathematical proofs in analysis.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of this course unit students should be able to<br>• identify, apply and manipulate elementary logical expressions<br>• classify real numbers and analyze their properties with proofs<br>• discuss analyze convergence and divergence of sequences of numbers<br>• identify continuity of functions<br>• find limits and derivatives of functions<br>• demonstrate the knowledge of the content of the major theorems associated with real numbers, sequences, functions and derivatives of functions<br>• prove lemmas and theorems on real numbers and functions and to make direct applications of those theorems to real problems.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Elementary Logic: Propositions, Mathematical Statements, Logical Operators, Connectives, Truth Tables, Tautologies and Contradictions, Logical Equivalence, Quantifiers, Order of Quantifiers, Proofs.<br>The Real Number System: Definition, Algebraic Axioms, Field Axioms, Ordered Fields. Related Theorems, Rational and Irrational Numbers, Upper and Lower Bounds, Least upper bound (sup) and greatest lower bounds (inf) andrelated theorems, completeness Axiom, Induction principle, Inequalities, Functions.<br>Sequences: Introducing sequences, Convergence of sequences and related theorems, Divergent sequences, subsequences and related results, Monotone sequences and Monotone convergence theorems.<br>Limits and Continuity of Functions Limits of Functions, Basic idea and epsilon-delta definition, related theorems, Continuity of functions at a point and in an interval, Continuity using epsilon-delta, basic consequences of continuity, Uniform continuity (optional).<br>Differentiability: Differentiable functions, Rules of differentiation, Related theorems, Rolle's Theorem, Mean Value Theorems and consequences, Maxima Minima and Critical points of real valued functions, L'Hospital Rule.</td></tr>
<tr><td colspan="6">Method of Teaching and Learning: Lectures, Tutorials and Reading Materials</td></tr>
<tr><td colspan="6">Methods of Assessment: Assessment test 20%End Semester Written Examination 80%</td></tr>
<tr><td colspan="6">References:<br>• David Brannan, A first course in Mathematical Analysis, Cambridge University Press, 2006.<br>• Deshpande, J.V., Mathematical Analysis and Applications (An Introduction), Narosha Publishing House, India 2005.<br>• Apostol, Tom M. Calculus, Volume 1. John Wiley & Sons, 1991.<br>• Apostol, Tom M. One-variable calculus, with an introduction to linear algebra. Second Edition, New York: John Wiley and Sons (1967).</td></tr>
</table>

**Mathematics Level II - Semester I**

MAT211β: Linear Algebra (30 lecture hrs + 15 tutorial hrs) -( Credit Value 2.5)

<table>
<tr><td>Course Unit number</td><td>MAT211β</td><td>Course Unit Title</td><td colspan="3">Linear Algebra</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Lectures (Hrs)</td><td>Tutorial (Hrs)</td><td>Independent learning (Hrs)</td><td>Pre-requisites</td></tr>
<tr><td>Notional hours</td><td>125</td><td>30</td><td>15</td><td>80</td><td>MPM1113</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="4">The objectives of this course unit is to<br>• provide students with a good understanding of the concepts and methods of linear algebra.<br>• help the students develop the ability to solve problems using linear algebra.<br>• connect linear algebra to other fields.<br>• develop abstract and critical reasoning by studying logical proofs and the axiomatic methods as applied to linear algebra.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On successful completion of this course unit students will be able to<br>• solve systems of equations using matrix algebra<br>• explain the concepts and methods of liner algebra.<br>• solve problems using linear algebra.<br>• describe complex logical arguments and develop modest logical arguments.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Matrices and operations on matrices, Elementary transformations, elementary matrices, row echelon form (REF) and reduced row echelon form (RREF) of a matrix, normal forms, Systems of linear equations and their solutions,<br><br>Real n-dimensional vector spaces, abstract vector spaces and their axioms, subspaces, linear independence and dependence, bases for vector spaces, dimension theorem, dual spaces,<br><br>Solutions of linear systems using matrix rank,<br><br>Linear transformations from one vector space to another, kernel and image of a linear transformation and related theorems,<br><br>Eigenvectors, Eigen values, Cayley-Hamilton theorem and its applications, matrix diagonalization, minimal polynomial.</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="4">Teaching: Lectures, class discussion, tutorial discussion.<br>Independent Learning: preparation for lectures/tutorials (30 hrs), group discussions (10 hrs), homework (25 hrs), referring library books/Internet sources (15 hrs)</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Semester End Examination : 100%</td></tr>
<tr><td colspan="6">References<br>• David Brannan, A first course in Mathematical Analysis, Cambridge University Press, 2006.<br>• Deshpande, J.V., Mathematical Analysis and Applications (An Introduction), Narosha Publishing House, India 2005.<br>• Apostol, Tom M. Calculus, Volume 1. John Wiley & Sons, 1991.<br>• Apostol, Tom M. One-variable calculus, with an introduction to linear algebra. Second Edition, New York: John Wiley and Sons (1967).</td></tr>
</table>

MAT212β: Real Analysis-I (30 lecture hrs + 15 tutorial hrs) -(Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT212β</td><td>Course Unit Title</td><td colspan="3">Real Analysis II</td></tr>
<tr><td>Lectures (Hr)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">MAT112β</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Tutorial (Hr)</td><td>15</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="4">The objectives of this course unit are to provide the students with the understanding of<br>• different forms of infinite sequences and series, and their convergences<br>• the concept of Riemann Integration of functions</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit the students will be able to:<br>• define series<br>• discuss the convergence of sequences and series<br>• apply the criteria (root, ratio and integral tests) forestablishing convergence of series and identify series that do not converge<br>• find the radius of convergence of a series<br>• evaluate definite integrals and find areas under functions using Riemann Integration<br>• define the Riemann Integrability of functions<br>• to prove related theorems on the properties of Riemann Integrals</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Theory of Series:Infinite series with positive terms. Tests for Convergence. Alternative series, Convergence of series. Brief introduction to convergence of series of functions<br><br>Riemann Integration: Partitions and Riemann sums. Upper and lower Riemann integrals. Necessary and sufficient condition for integrability. Properties of integrable functions.</td></tr>
<tr><td colspan="2">Method of teaching and learning:</td><td colspan="4">Lectures, Reading materials, Class discussions, Tutorial discussions</td></tr>
<tr><td colspan="2">Method of Assessment:</td><td colspan="4">Semester End Written Examination: 100%</td></tr>
<tr><td colspan="2">References:</td><td colspan="4">• Malik, Subhash Chandra, and Savita Arora. Mathematical analysis. New Age International, 1992.<br>• Shanthi Narayan, M.D. Raisinghania , Elements of Real Analysis, S Chand & Co Ltd, 2003.<br>• Brannan, David Alexander. A first course in mathematical analysis. Cambridge University Press, 2006.</td></tr>
</table>

**Mathematics Level II - Semester II**

MAT221β: Number Theory (30 lecture hrs + 15 tutorial hrs) -(Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT221β</td><td>Course Unit Title</td><td colspan="3">Number Theory</td></tr>
<tr><td>Lectures (Hr)</td><td>30</td><td rowspan="2">GPA/NGPA</td><td rowspan="2">GPA</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Tutorials (Hr)</td><td>15</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="4">The objectives of this course unit are to provide students a knowledge<br>• about the properties of Integers and Prime numbers<br>• how to solve linear Diophantine equations<br>• how to solve linear congruences and systems of linear congruences</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">After successfully completing this course, students will be able to<br>• apply the properties of integers, prime numbers and number theoretic functions to solve various types of mathematical problems<br>• solve linear Diophantine equations and apply them in practical problems<br>• solve linear congruences, systems of linear congruencesand apply them in practical problems</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">• Properties of Integers&Prime Numbers<br>• Number Theoretic Functions<br>• Theory of Congruences<br>• Systems of Linear Congruences (Chinese Remainder Theorem)<br>• Primitive Roots<br>• Quadratic Congruencies<br>• The Fermat Last Theorem</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="4">Conducting Lecture and Tutorial classes</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Mid semester examination – 20%<br>Endsemester examination– 80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• Theory of numbers: a textbook- by Ramachandra, K<br>• An introduction tothe theory of numbers - by Hardy G.H; Wright E.M.<br>• Elementary Number Theory- by Burton, David M.<br>• Beginning Number Theory – by Robbins, Nerville</td></tr>
</table>

MAT222δ: Real Analysis-II (15 lecture hrs + 7 tutorial hrs) -(Credit Value 1.25)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT222δ</td><td>Course Unit Title</td><td colspan="3">Real Analysis</td></tr>
<tr><td>Lectures (hrs.)</td><td>15</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>1.25</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td>Course Unit Objectives</td><td colspan="5">The objectives of this course unit is<br>• to introduce students to the basic ideas of functional sequence and functi<br>• to develop the theory of functional sequence and functional series from basic principles, giving the student of mathematics the ability to construct, analyse, and critique mathematical proofs in analysis.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">On completion of the course unit, students should be able to<br>• define a function functional sequence and functional series, point wise convergence, uniform convergence.<br>• find the limit function and the limit sum.<br>• discuss the condition(s) for a functional sequence to be continuous, bounded, differentiable and integral on a respected interval.<br>• Taking decision on uniform convergence problems using M_n test function functional sequence.<br>• Taking decision on uniform convergence problems using Weierstrass M – test of functional series.</td></tr>
<tr><td>Course Content</td><td colspan="5">Sequences and series of functions, Point-wise convergence of sequence of functions, Uniform convergence of sequence<br><br>of functions, Convergence and Uniform convergence of series of functions, Integration and differentiation of series<br><br>of functions.</td></tr>
<tr><td>Methods of teaching and learning</td><td colspan="5">Through lectures and tutorial discussions.</td></tr>
<tr><td>Method of Assessment</td><td colspan="5">Continuous assessment 20%<br><br>End Semester Examination 80%</td></tr>
<tr><td>References</td><td colspan="5">• Malik, Subhash Chandra, and Savita Arora. Mathematical analysis. New Age International, 1992.<br>• Shanthi Narayan, M.D. Raisinghania , Elements of Real Analysis, S Chand & Co Ltd, 2003.</td></tr>
</table>

MAT224δ: Geometry (15 lecture hrs + 8 tutorial hrs) -(Credit Value 1.25)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT224δ</td><td>Course Unit Title</td><td colspan="3">Geometry</td></tr>
<tr><td>Lectures (Hr)</td><td>15</td><td rowspan="2">Pre-requisites</td><td rowspan="2">A/L Combined Maths</td></tr>
<tr><td>Credits</td><td>1.25</td><td>Tutorial (Hr)</td><td>8</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit are to provide the students the concepts and properties of 2-D and 3-D Geometry.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit the students will be able to:<br>• solve problems in 2-D geometry<br>• solve problems in 3-D geometry</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">• Various forms of the equation of a plane<br>• Straight line<br>• Various forms of the equation of a sphere<br>• Some of the conicoid surfaces and their equations:Ellipsoid, Hyperboloid of one sheet, Hyperboloid of two sheet,tangent plane and normal line.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures, tutorial, group discussion, problem solving, reading materials</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment -20%<br>End Semester Examination – 80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• Jain, P. K. A Textbook of Analytical Geometry of Three Dimensions. New Age International, 2005.<br>• Chatterjee, Dipak. Analytic Solid Geometry. PHI Learning Pvt. Ltd., 2003.<br>• Zameeruddin, Q. and Khanna, V.K.,Solid Geometry,Vikas Publishing House Private, Limited, 1987.</td></tr>
</table>

MAT225β : Mathematical Statistics-I (30 lecture hrs + 15 tutorial hrs) -Prerequisite MAT113δ (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT225β</td><td>Course Unit Title</td><td colspan="3">Mathematical Statistics I</td></tr>
<tr><td>Lectures (hrs.)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">MAT113δ</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objective of this course unit is to provide students with basic knowledge of two dimensional random variables and with skills of applying sampling distributions and other main distributions</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course the student should be able to:<br>• Solve real world problems associated with joint probability distributions<br>• apply ideas and theorems of sampling distribution for other distributions<br>• use various statistical distributions for decision making considering test statistics</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Joint Distributions :Joint probability distributions, Joint Cumulative Distribution functions, Conditional Distribution functions, Independence and Expectations, Expectation and Variance of linear functions of random variables, Joint Moment Generating functions and Joint moments, Covariance and correlation coefficients<br><br>Distribution of functions of random variables:Cumulative Distribution Function technique, Moment Generatingfunction technique, Transformation technique.<br><br>Order Statistics<br><br>Sampling distributions: Random sample, Statistic, Sample moment, Sample mean, Sample variance, Sampling Distributions related to the Normal Distribution. The Distribution of sample mean, Laws of Large numbers, Central Limit theorem with proof,<br><br>Other distributions:Chi-square Distribution, F Distribution, Student-t-Distribution</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures, Group Discussions, Reading materials, Problem solving, Tutorials</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment – 20%<br>End Semester Examination - 80%</td></tr>
</table>

**References**


- Wackerly, Dennis, William Mendenhall, and Richard L. Scheaffer. *Mathematical statistics with applications*. Sixth Edition, Cengage Learning, 2014.
- Freund, John E., and Ronald E. Walpole. *Mathematical Statistics Englewood Cliffs*. (1980).
- Sahoo, Prasanna. Probability and mathematical statistics, *University of Louisville* (2013).

**Mathematics Level III - Semester I**

MAT311β: Group Theory (30 lecture hrs + 15 tutorial hrs) -(Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT311β</td><td>Course Unit Title</td><td colspan="4">Group Theory</td></tr>
<tr><td>Lecture (Hrs)<br><br>Tutorials</td><td colspan="2">30<br><br>15</td><td rowspan="2">Pre-requisites</td><td rowspan="2">MAT121β</td></tr>
<tr><td>Credits</td><td>2</td><td>Practical (Hrs)</td><td colspan="2">-</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="5">The objective of this course unit is to provide the students the basic concepts of group theory</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">On successful completion  of the course unit, the student should be able to:<br>● explain the basic concepts of groups.<br>● demonstrate knowledge of the content of the major theorems.<br>● use appropriate ideas for the proofs of the theorems.<br>● apply concepts of groups and theories to real problems.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="5">Groups and subgroups: Definition and examples of Groups, Baic properties of Groups, Subgroups, Cyclic Groups.<br><br>Permutation Groups: Definition and Notations, Properties of and manipulate permutations,<br><br>Cosets and Lagrange’s Theorem: Properties of Cosets, Lagrange’s Theorem and Consequences, An application of Cosets to Permutation Groups, Normal Subgroups and Quotient Groups.<br><br>Group Homomorphisms and Isomorphisms: Definitions and Examples of Group Homomorphism and Isomorphism. Properties of Homomorphisms. Fundermental Theorem of Group Homomorphism, Properties of Isomorphisms.</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="5">Lectures, Tutorials and Reading Materials</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Assessment test  : 20%  ,  End semester Written  Examination : 80%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">• Vijay K. Kanna & S.K. Bhambri, A Course in Abstract Algebra, Vikas Publishing, 2017.<br>• Joseph A. Gallian, Contemporary abstract algebra, 1991: 374-375.<br>• Hungerford, Thomas W. Abstract algebra: an introduction. Cengage Learning, 2012.<br>• Any Algebra, Abstract Algebra book</td></tr>
</table>

MAT312β: Real Analysis-III (30 lecture hrs + 15 tutorial hrs) -( Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT312β</td><td colspan="2">Course Unit Title</td><td colspan="4">Real Analysis III</td></tr>
<tr><td colspan="3">Lectures & Tutorials (Hr)</td><td>45</td><td rowspan="2">Pre-requisites</td><td rowspan="2"></td></tr>
<tr><td>Credits</td><td>2.5</td><td colspan="3">Lab (Hr)</td><td>-</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="6">Objectives of this course unit are to provide students with<ul><li>knowledge of open sets, closed sets and limit points in multidimensional spaces.</li><li>explanation of the properties of real valued and vector valued multivariable functions (eg. Limits, Continuity, Derivatives)</li><li>knowledge on how to find and classify extrema of multivariable functions with and without constraints..</li></ul></td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="6">On completion of the course unit student should be able to:<br>● Identify the properties of subsets in multidimensional spaces (eg, Closed sets, Open sets, Limit points).<br>● Find Directional derivatives, Partial derivatives, Total derivatives, Gradients of multivariable functions.<br>● Explain Continuity and Differentiability of real valued and vector valued multivariable functions.<br>● Identify sufficient conditions for the equality of mixed partial derivatives of multivariable functions.<br>● Identify the Extremes and their types of multivariable functions with and without constraints.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="6">Open sets, Open balls, Closed sets, Limit points in Rn. Real valued and vector valued functions in multidimensional spaces, Limits and continuity, The Derivatives of scalar field with respect to a vector. Directional derivatives, Partial derivatives, Partial derivatives of higher order, The total derivatives, The Gradient of Scalar field, A sufficient condition for differentiability, A chain rule for derivatives of scalar field, Derivatives of vector fields,<br>Differentiability implies continuity, The chain rule for derivatives of vector field, sufficient conditions for equality of mixed partial derivatives, Derivatives of functions defined implicitly. Classification of extrema of multivariable functions. Extrema with constraints using Lagranges Multipliers. Double integrals.</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="6">Lectures, Reading materials, Tutorial discussions</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="6">Semester end Examination : 80%<br>Mid semester Examination : 20%</td></tr>
<tr><td colspan="2">References</td><td colspan="6"><ul><li>Mathematical Analysis, Malik</li><li>The calculus with several variables Part II, Louis Leithold.</li><li>Calculus, Elliott Mendelson.</li><li>Elementary Multivariable Calculus, Bernard Kolman, William, F.Trench</li></ul></td></tr>
</table>

MAT313β: Mathematical Statistics-II (30 lecture hrs + 15 tutorial hrs) -(Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT313$\beta$</td><td>Course Unit Title</td><td colspan="4">Mathematical Statistics II</td></tr>
<tr><td colspan="2">Lectures (Hr)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">MAT225β</td></tr>
<tr><td>Credits</td><td>2.5</td><td colspan="2">Tutorials (Hr)</td><td>15</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="5">The objective of this course unit is to introduce the main ideas of mathematical statistics such as point estimation, interval estimation and hypothesis testing.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">On completion of this course unit the students will be able to<br>• estimate population parameters.<br>• identify the properties of estimators<br>• discuss the concept of confidence interval<br>• construct a confidence interval for a population parameter.<br>• formulate null and alternative hypotheses.<br>• determine which test statistic is suitable for a testing procedure.<br>• select the level of significance and the criteria for rejection of the null hypotheses</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="5">Point estimation: The method of moments, The method of Maximum Likelihood, Properties of point estimation: Unbiasedness, Efficiency, Consistency, Sufficiency, Minimal Sufficient Statistics, Exponential family, Cramer - Rao Inequality, Completeness.<br>Interval Estimation: Confidence Interval for the mean and variance.<br>Tests of Hypotheses: Simple Hypothesis, Composite Hypothesis, Critical Region, Types of Error, Power Function, Size of Test, Simple Likelihood-ratio Test, Most powerful Test, Neyman-Pearson lemma, Generalized Likelihood ratio Test, Uniformly Most Powerful Test, Tests of Hypotheses - Sampling from the Normal Distribution.</td></tr>
<tr><td colspan="7">Method of teaching and learning: Lectures, Discussions and Reading materials</td></tr>
<tr><td colspan="7">Method of Assessment: Continuous assessments : 20%<br>Semester End written Examination : 80%</td></tr>
<tr><td colspan="7">References:<br>• Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability & statistics for engineers & scientists, , 9th ed.<br>• Wackerly, Dennis, William Mendenhall, and Richard L. Scheaffer. Mathematical statistics with applications. Sixth Edition, Cengage Learning, 2014<br>• J. Susan Milton, Jesse C. Arnold, Introduction to Probability and Statistics,</td></tr>
</table>

**Industrial Mathematics Level I - Semester I**

IMT111β: Classical Mechanics-I (Dynamics) (30 lecture hrs + 15 tutorial hrs) -(Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">IMT111β/<br>AMT111β</td><td>Course Unit Title</td><td colspan="3">Classical Mechanics I (Dynamics)</td></tr>
<tr><td>Lectures (hrs.)</td><td>45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">A/L Combined Mathematics</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit is<br><br>• basic concepts in Dynamics and applications of Newton’s second law for the motion of a particle and systems of particles.<br>• motion of a rigid body.<br>• how to use Lagrange’s and Hamiltonian equations to solve problems in Dynamics.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">• On completion of the course unit, students should be able to<br>• describe motion of a particle, a system of particles and a rigid body<br>• apply Lagrange’s and Hamiltonian equations to solve problems in Dynan</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Frame of reference. Inertial frames, Forces, Velocity, Acceleration, Linear Momentum, Angular velocity, Angular momentum, Motion of a particle (Newton’s laws), Motion of a system of particles, moments and products of inertia, Parallel axes theorem, Perpendicular axes theorem for moments and products of inertia, Principle axes and principle moments of inertia, Euler Equations for motion of a rigid body with one point fixed, generalized coordinates, Lagrange’s formulations, Hamiltonian functions.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Reading material, Lectures, Tutorial Classes, Discussion, Videos</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment: 20%<br>End Semester Examination:80%</td></tr>
<tr><td colspan="6">References<br>• Loney, S. L. Dynamics of a Particle and of Rigid Bodies. Bull. Amer. Math. Soc 17 (1911): 211-212.<br>• R Spiegel, Murray, Mathematical Mechanic<br>• R Spiegel, Murray, Theoretical Mechanics<br>• R Spiegel, Murray. Theory and Problems of Theoretical Mechanics (Schaums Outline), 2021.<br>• Bali, N.P., Golden Dynamics, Laxmi Publications Pvt Limited, 2011</td></tr>
</table>

IMT1b2β: Mathematical Computing (15 lecture hrs + 60 practical hrs) -(Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">IMT 1b2β</td><td>Course Unit Title</td><td colspan="3">Mathematical Computing</td></tr>
<tr><td>Lectures (hrs.)</td><td>15</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Practical (hrs.)</td><td>60</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objective of this course unit is to provide the students the ability to write C programs on UNIX system to solve some mathematical and practical problems.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to,<br>• discuss the basic introduction to computer system and its generations.<br>• apply the knowledge to working with Linux operating system.<br>• perform mathematical concepts and procedures in C language.<br>• develop C program to practical problems.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Introduction to computer system and its historical development<br>Numerical computation and mechanical computer devices<br>computer architecture, hardware, software and liveware , programming languages, application packages<br>Introduction to Linux Operating System<br>UNIX commands, directory structure, text editors<br>Programming with C on UNIX system<br>editing (with emacs), compilation, debugging, Formatted input-output, control structures, C loops, C functions, pointers, arrays</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures, Reading Materials, Assignment basedlearning as practical session.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Semester I Examination (Mid 20% + End semester 80%) :30%<br>Semester II Examination (Project report): 35%<br>Semester II Examination (Viva): 35%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">C Programming: A Modern Approach by K.N. King<br>Any C Programming Book</td></tr>
</table>

**Industrial Mathematics** Level I - Semester II

IMT121β: Classical Mechanics-II (Statics) (30 lecture hrs + 15 tutorial hrs) -(Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">IMT/AMT 121b</td><td>Course Unit Title</td><td colspan="3">Classical Mechanics II (Statics)</td></tr>
<tr><td>Lectures (hrs.)</td><td>45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit is<br>• Concepts of force, moment, and mechanical equilibrium.<br>• Analyze forces and moments in 2D and 3D.<br>• Analyze distributed forces and internal loads.<br>• Analyze forces in various systems such as beams and cables.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to<br>• Analyze the properties (components, resultants, and moments) of a force and force systems in 2D& 3D.<br>• Solve equilibrium problems of various types of structures using analytical models, rigid bodies, FBDs and equations of equilibrium.<br>• Represent a distributed line or area load by an equivalent point force, and use the equivalent point force in static analysis.<br>• Identify the equilibrium analysis of beams and cables.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Theory of Forces and Couples: Force acting at a point, Resultant of a system of forces acting at a point, Condition for equilibrium of a system of forces acting at a point, Vector moment of a force, Couple, Moment of a couple, Resultant of a system of forces in 3D, Invariant, Wrench, Coplanar system of forces, Varignon's Theorem of moments, Parallel systems, Conjugate forces.<br>Bending of Beams:Shear and bending moment in a beam, Relations among Load, Shear and bending moment, Thin elastic beams, Bernoulli-Euler law, Macaulay's notation, Clapeyron's equation for three moments.<br>The Catenary:Flexibility, The common catenary, Parabolic chain, Suspension bridge, Catenary of uniform strength, General equations of equilibrium of a string in one plane under given forces, Strings on rough curves, Variable chain hanging under gravity.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Reading material, Lectures, Tutorial Classes, Discussion, Videos</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment -20%<br>End Semester Examination -80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• A.S. Ramsey, Statics.<br>• N.P. Bali, Golden Statics,<br>• R.C. Hibbeler, Engineering Mechanics-Statics</td></tr>
</table>

IMT122β : Mathematical Modelling-I (30 lecture hrs + 15 tutorial hrs) -Prerequisite MAT112δ (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">AMT/IMT 122β</td><td>Course Unit Title</td><td colspan="4">Mathematical Modelling - 1</td></tr>
<tr><td colspan="2">Lectures & Tutorials (Hr)</td><td>45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">MAT112δ</td></tr>
<tr><td>Credits</td><td>2.5</td><td colspan="2">Lab (Hr)</td><td>-</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="5">The objective of this course unit is to provide the students with some basic modeling skills, which will have applications to wide variety of problems.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">On completion of the course unit student should be able to:<br>● apply the knowledge to develop discreet and (or) continuous mathematical model for a real situation.<br>● obtain the solutions for the model and classify the equilibrium solutions.<br>● analyse the solutions using a variety of techniques with theoretical and graphical Methods.<br>● explain the behavior of the model.<br>● discuss the validation of the model.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="5">Introduction: General Introduction to Modelling, concepts of system identification, Deterministic vs Stochastic, classification of models.<br>Modelling via First Order Differential Equations:Modelling Through First Order and Simple Higher Order Differential Equations, Linear Differential Equations (LDEs), systems of Ordinary Differential Equations (ODEs).<br>Analysis of Solutions: Existence and uniqueness of solutions, continuation of solutions, dependence on initial conditions and parameters, linear systems of equations with constant and variable coefficients, autonomous systems, phase space, and stability, Interpretation of solutions in modelling.<br>Applications: Population ecology, chemical kinetics, traffic dynamics, Mechanics, Biology and Medicine, Pharmokinetics, Economics, Engineering, Special topics in modelling.</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="5">Lectures, Reading materials, Tutorial discussions</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Semester end Examination : 80%<br>Mid semester Examination : 20%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">• Barnes, B., G.. R. Fulford, and Glenn Fulford. Mathematical Modelling with Case Studies. Chapman and Hall/CRC, 2014.<br>• James Sandefur, Elementary Mathematical Modelling: A Dynamic Approach , 1sr Edition, Brooks Cole, 2002.<br>• Kapur, Jagat Narain. Mathematical modelling. New Age International, 1988.<br>• Any Mathematical Modelling Book</td></tr>
</table>

**Industrial Mathematics Level II - Semester I**

IMT211β: Classical Mechanics-III (Fluid Dynamics) (30 lecture hrs + 15 tutorial hrs) -(Credit Value 2.5)

<table>
<tr><td rowspan="2">Course unit number</td><td rowspan="2">IMT211β</td><td>Course unit Title</td><td colspan="3">Classical Mechanics III(Fluid Dynamics)</td></tr>
<tr><td rowspan="2">Lectures and Tutorials (Hr)</td><td rowspan="2">45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">A/L Combined Mathematics</td></tr>
<tr><td>Credits</td><td>2.5</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="4">The objectives of this course unit is to explain:<br>• basic concepts in Dynamics and applications of Newton’s second law for the motion of a particle and systems of particles.<br>• concepts of fluid dynamics.<br>• kinematics and dynamics of fluid motion.<br>• Flow field around 2D and 3D objects using combination of fundamental potential flow solutions.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">After the successful completion of this course unit, students should be able to<br>• Identify types of fluid flows<br>• distinguish difference between steady/unsteady, uniform/non-uniform, compressible/incompressible flow<br>• describe concepts necessary to analyse fluid motion<br>• identify stream lines, path lines and vortex lines,<br>• use continuity, Euler and Bernoulli equations</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Fluid Dynamics: Types of flows, Equations of stream, path and vortex lines, Equation of continuity, Euler’s and Bernoulli’s equations, Irrotational motion, Uniqueness theorem, Kinetic energy, potential flow, sources and Sinks in 2D and 3D Images, Milne Thompson Theorem</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="4">Reading material, Lectures, Problems Solving</td></tr>
<tr><td colspan="2">Method of Assessment:</td><td colspan="4">Continuous assessment:20%<br>Semester End Examination:80%</td></tr>
<tr><td colspan="6">References<br>• Chorlton, Frank. Textbook of fluid dynamics. Van Nostrand Company, 1967.<br>• Green, A. E. Theoretical Hydrodynamics.</td></tr>
</table>

IMT2b2β : Mathematical Computing (15 lecture hrs + 60 practical hrs) -(Credit Value 2.5)

| | | | | | |
|---|---|---|---|---|---|
| **Course Unit number** | IMT2b2β | **Course Unit Title** | Mathematical Computing (MATLAB) | | |
| | | **Lectures (hrs.)** | 15 | **Pre-requisites** | None |
| **Credits** | 2.5 | **Practical (hrs.)** | 30 | | |
| **Course Unit Objectives** | | The objectives of this course unit is<br>• using of MATLAB as a scientific calculator<br>• description related to build in functions in MATLAB<br>• the ability to write MATLAB programs using script and functions<br>• the programing skills to write codes to obtain analytical solutions and numerical approximation solutions for the existing models | | | |
| **Learning Outcomes** | | On completion of the course unit, students should be able to<br>• learn basic of MATLAB programing<br>• perform program for solving system of linear equations and system of differential equations<br>• use MATLAB codes for obtaining numerical approximations for nonlinear system of differential equations<br>• provide plots such as 2D and 3D for complex functions<br>• implement algorithms and MARLAB codes for real applications modeled by using non-linear equations, system of equations and system of differential equations. | | | |
| **Course Content** | | MATLAB workplace :Overview of MATLAB features and workplace, using MATLAB command window as a scientific calculator, handling with variables, saving variables in files with extension mat, formatting output, arrays, matrices, matrix functions<br><br>Script and functions:Simple MATLAB codes for matrix manipulations, finding roots, evaluating polynomials, structural programing, for loop, while loop, if, else if, 2D and 3D Plots, use of MATLAB for solving nonlinear equations, numerical differentiation and integration, solving linear systems, solving ordinary differential equations, solving and plotting numerical solutions of system of differential equations, MATLAB codes construction for curve fittings | | | |
| **Methods of teaching and learning** | | Lectures and practical sessions | | | |
| **Method of Assessment** | | Semester I Examination (Mid 20% + End semester 80%) :30%<br>Semester II Examination (Project report): 35%<br>Semester II Examination (Viva): 35% | | | |
| **References** | | Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists, McGraw-Hill, 3rd edition, 2012. | | | |

**Industrial Mathematics Level II - Semester II**

IMT221β: Mathematical Modelling-II (30 lecture hrs + 15 tutorial hrs) -Prerequisite IMT122β (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">AMT/IMT 221ß</td><td>Course Unit Title</td><td colspan="3">Mathematical Modelling II</td></tr>
<tr><td>Lectures (hrs.)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">Mathematical Modelling-I (AMT/IMT 121ß)</td></tr>
<tr><td>Credits</td><td>2</td><td>Tutorials (hrs.)</td><td>15</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit are to give<br>• the ability in modelling the real world problems through ordinary differential equations(ODE), difference equations and partial differential equations(PDE),<br>• the ability of solving ODEs, system of ODEs and PDEs analytically and numerically</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">After successful completion of this course, students should be able to<br>• construct mathematical models for real world problems using<br>(i) ordinary differential equations or systems of differential equations, difference equations<br>(ii)first order linear or quasi linear partial differential equations, second order partial differential equations<br>• solve modelling problems in (i) using different numerical methods<br>• solve modelling problems in (ii) using different analytical methods</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Introductory Numerical Solutions of Differential Equations, Mathematical Modelling through Difference Equations, Further Study on Systems of Differential Equations with Matrices. Modelling with Partial Differential Equations (PDEs): The concept of a PDE, Method ofseparation of variables, Mass-Balance equation (The first method of obtaining PDE Models), Momentum-Balance Equation (The second method of obtaining PDE Models), Variational Principles (The third method of obtaining PDE Models), Probability Generating functions (The fourth method of obtaining PDE Models), Nature of PDEs Initial and Boundary Conditions.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures, discussions during the lectures, tutorial discussion.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment -20%<br>End Semester Examination - 80%</td></tr>
</table>

**References**


- Neil Gershenfeld, *The Nature of Mathematical Modeling*, Cambridge University Press, 2011.
- B. Barnes, G.R. Fulford, *Mathematical Modelling with Case Studies: A Differential Equations Approach using Maple and MATLAB*, Second Edition, CRC Press, 2002
- Griffiths**,** David**,** Higham**,** Desmond J., *Numerical Methods for Ordinary Differential Equations -Initial Value Problems*, Springer, Undergraduate Mathematics Series, 2012.
- Walter Strauss, *Introduction to Partial Differential Equations*, 2nd edition, John Wiley & Sons, 2008.

IMT223β: Applied Probability (Information Theory)(30 lecture hrs + 15 tutorial hrs) -Op. for students following Industrial Mathematics (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">AMT/IMT223β</td><td>Course Unit Title</td><td colspan="3">Applied Probability (Information Theory)</td></tr>
<tr><td>Lectures (hrs.)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2</td><td>Tutorials (hrs.)</td><td>15</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit are<br>• to learn basic concepts in Information Theory<br>• to gain knowledge on how Probability Theory is used to quantify information and to model a communication channel<br>• to investigate how Information Theory is related to other fields of Science and Mathematics</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to<br>• appreciate the contribution of Information Theory for the development of Information Technology<br>• apply basic techniques, results and concepts in Information Theory to quantify and process information.<br>• understand applications of Information Theory in other fields.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Elementary Probability Theory: discrete and continuous random variables, probability distributions, laws of large numbers, modes of convergence, Markov and Chebyshev inequalities<br>Introduction to Information Theory:Claud E Shannon- the father of information theory, Information measures – entropy, joint entropy, conditional entropy, relative entropy, mutual information. Convex/concave functions, Jensen’s inequality and its consequences, log-sum inequality and its applications, Data processing inequality, Asymptotic equipartition property, how to model a communication channel, Channel capacity, Noiseless Binary Channel, Binary Symmetric Channel<br>Fundamentals of Data Compression: Kraft inequality, Huffman coding.<br>Brief Introduction to Information Geometry: Manifold of probability distributions/densities, Fisher information, exponential family</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures: 30 hrs (2 hrs per week)<br>Tutorial classes: 15 hrs (1 hr per week)</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment: 20%<br>End Semester Examination:80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• Sheldon Ross, A First Course in Probability Theory, Pearson Education, 2002.<br>• David Applebaum, Probability and Information, Cambridge University Press, 1996.</td></tr>
</table>

IMT224β: Applied Statistics-I (30 lecture hrs + 15 tutorial hrs) -Op. for students following Industrial Mathematics (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">AMT224β /IMT224β</td><td colspan="2">Course Unit Title</td><td colspan="4">Applied Statistics-I</td></tr>
<tr><td colspan="3">Lectures (Hr)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2"></td></tr>
<tr><td>Credits</td><td>2.5</td><td colspan="3">Tutorials (Hr)</td><td>15</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="6">The objective of this course unit is to provide the students the ability to solve some practical problems by statistical methods. It will help students to develop skills in thinking and analysing problems from a probabilistic and statistical point of view.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="6">After the successful completion of this course unit, the students should be able to<br>• explain concepts of probability and statistics.<br>• evaluate various quantities of probability distributions and random variables.<br>• develop probabilistic and statistical models for some applications<br>• apply statistical methods to a range of problems in science, engineering and sociology etc.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="6">Collecting and Summarizing data: Constructing tables and graphs, Measures of center of a set of observations, Median, Arithmetic Mean, Mode.<br>Samples and Populations: Methods of choosing a sample, Measures of variability: Range, Mean<br>deviation, Variance and Standard deviation, Semi-interquartile range, five number summaries, Box and Whisker plots, stem and leaf plots.<br>Joint distributions of data: The Scatter diagram, the concept of a statistical relation, Quantitative<br>description of a statistical relation, Covariance, Correlation coefficient.<br>Linear regression: Regression equation, Prediction and error, Interpreting regression.<br>Statistical Applications with probability models: Bernoulli, Binomial, Poisson, Normal approximations.</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="6">Lectures , Reading materials and Tutorial discussion</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="6">Continuous assessments 20% and Semester End Written Examination80%</td></tr>
<tr><td colspan="2">References</td><td colspan="6">• Mark L.Berenson, Basic Business Statistics Concept and Applications, (519.5BER).<br>• HarrayJrankan, Steven C.Althoen, Statistics concept and applications, (519.5FRA).<br>• William G. Cochram, Sampling Theory.<br>• ,Jeffrey L.Bradney, Applied Statistics for Public Administration</td></tr>
</table>

**Industrial Mathematics Level III - Semester I**

IMT3b1β : Industrial Mathematics Project (90 project hrs) -(Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit</td><td rowspan="2">IMT3b1β</td><td colspan="2">Course Unit Title</td><td colspan="3">Mathematical Computing (JAVA)- Industrial Mathematics project</td></tr>
<tr><td colspan="2">Lectures (Hr)</td><td>15</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2.5</td><td colspan="2">Lab (Hr) (Sem I + Sem II)</td><td>60</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="5">The objectives of this course unit are to develop skills in<br>• solving mathematics related industrial problems or real world problems using object oriented programming,<br>• developing new mathematical algorithms and<br>• optimizing existing industry oriented algorithms.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">On the successful completion of this course unit students should be able to:<br>• suggest new algorithms to solve identified industry related mathematical problems or any real world problems.<br>• convert existing codes to Java to get reliable and efficient codes and reusing existing codes to solve problems.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="5">Introduction to JAVA: Fundamentals of programming such as variables, data types and operators, key words, control structure (decisions and loops), methods, arrays, access control.<br>Object Oriented Programming: Fundamentalsof object oriented programming (defining classes, abstraction, inheritance, polymorphism, encapsulation, interfaces).<br>Handling exceptions.</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="5">Lectures and Practical sessions</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Semester I Examination (Mid 20% + End semester 80%) :30%<br>Semester II Examination (Project report): 35%<br>Semester II Examination (Viva): 35%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">• Programming with Java: a primer by Balagurusamy<br>• Schaum's outline of theory and problems of programming with Java by Hubbard, John R.</td></tr>
</table>

IMT312β : Mathematical Modelling-III (30 lecture hrs + 15 tutorial hrs) -Op. for students following Industrial Mathematics ( Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">IMT312β</td><td>Course Unit Title</td><td colspan="3">Mathematical Modelling III</td></tr>
<tr><td>Lectures +Tutorial Discussions (hrs.)</td><td>45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>3</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The overall goal of the Mathematical Modelling III is to increase student awareness of the importance of mathematics in the modern world. Variety of modelling techniques that involve differential equations and graph theory will be discussed with examples taken from physics, biology, chemistry, economics and other fields. Laplace transforms as a tool to solve differential equations and basic theory of Graphs will be discussed.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">Upon successful completion of this course, the student will be able to:<ul><li>solve differential equations using Laplace transforms;</li><li>model practical problems that involve differential equations and solve the problems;</li><li>demonstrate the basic techniques of graph theory;</li><li>apply the graph theory knowledge to solve some network optimization problems.</li></ul></td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Solution of Linear Differential Equations by Laplace Transforms, Mathematical Modelling through Graphs, Mathematical Modelling Through Calculus of Variations and Dynamic Programming or Special Topics and/or Project, Stochastic Modelling, A survey on Ancient Sri Lankan Science and Technological Methods, Topics in Mathematical Modelling of Life Environmental relationships.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures, class discussion, tutorial discussion.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment: 20%<br>End Semester Examination:80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4"><ul><li>Mathematical Modelling, by J.N. Kapur</li><li>Graph Theory and Applications , by L.R. Foulds</li><li>An Introduction to Differential Equations and Their Applications, by S. J. Farlow</li></ul></td></tr>
</table>

IMT313β : Applied Statistics-II (30 lecture hrs + 15 tutorial hrs) -Op. for students following Industrial Mathematics, Prerequisite IMT224β (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">IMT313β<br>AMT314β</td><td>Course Unit Title</td><td colspan="3">Applied Statistics II</td></tr>
<tr><td>Lectures (hrs.)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">IMT224β<br>AMT224β</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit is to provide the students with the knowledge of hypothesis testing andability of handling non parametric tests.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to<br>• identify and apply the suitable parametric test for the real problems.<br>• apply the relevant non parametric test for the real problems.<br>• develop the knowledge of  decision making based on the test hypothesis and statistical tests.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Testing Hypothesis about one population mean and two population means<br>Testing Hypothesis about many population means:Introduction to analysis of variance, Linear models for analysis of variance, variability as sum of squares, Test statistics and rejection rules<br>The population regression: Formulating hypothesis about regression, Analysis of variance for regression<br>Non parametric tests: Chi-Square test, Test of independence, Kolmogorov-Smirnov test, Sign test, Mann-Whitney U-test, Runs test (one sample runs test, two sample runs test), Kruskal-Walis test</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures, tutorial, group discussion, problem solving, reading materials</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment - 20%<br>End Semester Examination – 80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• Larry J. Kitchens, Basic Statistics and Data Analysis<br>• Prem S. Mann, Introductory statistics<br>• Douglas C. Montgomery, George C. Runger, Statistics and Probability for engineers</td></tr>
</table>

**Industrial Mathematics Level III - Semester II**

Refer the Optional course units offered by the department of Mathematics for Level III- Semester II, for details.

**Applied Mathematics** Level I - Semester I

AMT111β : Classical Mechanics-I (Dynamics) (30 lecture hrs + 15 tutorial hrs) (Credit Value 2.5)

| | | | | | |
|---|---|---|---|---|---|
| **Course Unit number** | IMT111β/<br>AMT111β | **Course Unit Title** | Classical Mechanics I (Dynamics) | | |
| | | **Lectures (hrs.)** | 45 | **Pre-requisites** | A/L Combined Mathematics |
| **Credits** | 2.5 | **Practical (hrs.)** | | | |

| | |
|---|---|
| **Course Unit Objectives** | The objectives of this course unit is<br>• basic concepts in Dynamics and applications of Newton's second law for the motion of a particle and systems of particles.<br>• motion of a rigid body.<br>• how to use Lagrange's and Hamiltonian equations to solve problems in Dynamics. |
| **Learning Outcomes** | • On completion of the course unit, students should be able to<br>• describe motion of a particle, a system of particles and a rigid body<br>• apply Lagrange's and Hamiltonian equations to solve problems in Dynam |
| **Course Content** | Frame of reference. Inertial frames, Forces, Velocity, Acceleration, Linear Momentum, Angular velocity, Angular momentum, Motion of a particle (Newton's laws), Motion of a system of particles, moments and products of inertia, Parallel axes theorem, Perpendicular axes theorem for moments and products of inertia, Principle axes and principle moments of inertia, Euler Equations for motion of a rigid body with one point fixed, generalized coordinates, Lagrange's formulations, Hamiltonian functions. |
| **Methods of teaching and learning** | Reading material, Lectures, Tutorial Classes, Discussion, Videos |
| **Method of Assessment** | Continuous assessment: 20%<br>End Semester Examination:80% |

**References**


- S.L. Loney, Dynamics of particles and Rigid bodies
- Murray R, Spiegel, Mathematical Mechanic
- Murray R, Spiegel, Theoretical Mechanics
- Bali, N.P, Book of Dynamics, F. Chorlton.
- F.P. Beer, E.R. Johnston, J and P.J. Cornwell, Vector Mechanics for Engineers

AMT112β: Mathematical Foundation of Computer Science (30 lecture hrs + 15 tutorial hrs)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">AMT112β</td><td>Course Unit Title</td><td colspan="3">Mathematical Foundation of Computer Science</td></tr>
<tr><td>Lectures (hrs.)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Tutorials (hrs.)</td><td>15</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit is,<br><br>Provide knowledge to apply mathematical concepts in the areas of mathematical logic, various types of number systems and their properties, Boolean algebra and analysis of algorithms using mathematical concepts etc.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to<br>• Mathematical logic and logical reasoning.<br>• Different number systems and converting them from one system to another (especially Binary, Octal and Hexadecimal).<br>• Boolean algebra in construction of simple logic circuits.<br>• Proving the correctness of simple computer algorithms using mathematics.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Mathematical logic and logical reasoning: Syllogisms; Propositional logic; Logical connectives; Truth tables; Tautologies and contradictions; Logical equivalence; Conditional statements and variations; Arguments; Predicates, quantifiers and symbolic logic<br>Different number systems and converting them from one system to another:Present and the Roman; The Binary Number system; Octal Number System; Octal Number System; Hexadecimal Number System; Decimal/Binary conversion; Binary Arithmetic; Two’s Complement Arithmetic<br>Boolean algebra in construction of simple logic circuits : Boolean Variables and Constants; Axioms for a Boolean Algebra; Laws of Boolean Algebra; Disjunctive Normal Forms; Switching Circuits; Simplification of circuits; Logic Circuits; Minimization; Karnaugh Maps<br>Proving the correctness of simple computer algorithms using mathematics:Proof of Correctness; Assignment Rule; Conditional Rule; Loop Rules; Recursion and Recursive Relations; Solving Recurrence Relations; Linear first-order, constant coefficient recurrence relations; Analysis of Algorithms using Recurrence Relations</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Conducting lectures and tutorial classes</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment 20%<br><br>End Semester Examination 80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">Theory and Problems of Discrete Mathematics - Schaum’s outline series<br>Kenneth H. Rosen Discrete Mathematics and its Applications</td></tr>
</table>

## Applied Mathematics Level I - Semester II

AMT121β: Classical Mechanics-II (Statics) (30 lecture hrs + 15 tutorial hrs) (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">IMT/AMT 121b</td><td>Course Unit Title</td><td colspan="3">Classical Mechanics II (Statics)</td></tr>
<tr><td>Lectures (hrs.)</td><td>45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit is<br>• Concepts of force, moment, and mechanical equilibrium.<br>• Analyze forces and moments in 2D and 3D.<br>• Analyze distributed forces and internal loads.<br>• Analyze forces in various systems such as beams and cables.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to<br>• Analyze the properties (components, resultants, and moments) of a force and force systems in 2D& 3D.<br>• Solve equilibrium problems of various types of structures using analytical models, rigid bodies, FBDs and equations of equilibrium.<br>• Represent a distributed line or area load by an equivalent point force, and use the equivalent point force in static analysis.<br>• Identify the equilibrium analysis of beams and cables.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Theory of Forces and Couples: Force acting at a point, Resultant of a system of forces acting at a point, Condition for equilibrium of a system of forces acting at a point, Vector moment of a force, Couple, Moment of a couple, Resultant of a system of forces in 3D, Invariant, Wrench, Coplanar system of forces, Varignon's Theorem of moments, Parallel systems, Conjugate forces.<br><br>Bending of Beams:Shear and bending moment in a beam, Relations among Load, Shear and bending moment, Thin elastic beams, Bernoulli-Euler law, Macaulay's notation, Clapeyron's equation for three moments.<br><br>The Catenary:Flexibility, The common catenary, Parabolic chain, Suspension bridge, Catenary of uniform strength, General equations of equilibrium of a string in one plane under given forces, Strings on rough curves, Variable chain hanging under gravity.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Reading material, Lectures, Tutorial Classes, Discussion, Videos</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment: 20%<br>End Semester Examination:80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• A.S. Ramsey, Statics<br>• N.P. Bali, Golden Statics<br>• R.C. Hibbeler, Engineering Mechanics-Statics</td></tr>
</table>

AMT122β: Mathematical Modelling-I (30 lecture hrs + 15 tutorial hrs) (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">AMT/IMT 122β</td><td>Course Unit Title</td><td colspan="3">Mathematical Modelling - 1</td></tr>
<tr><td>Lectures & Tutorials (Hr)</td><td>45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">MAT112δ</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Lab (Hr)</td><td>-</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="4">The objective of this course unit is to provide the students with some basic modeling skills, which will have applications to wide variety of problems.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit student should be able to:<br>● apply the knowledge to develop discreet and (or) continuous mathematical model for a real situation.<br>● obtain the solutions for the model and classify the equilibrium solutions.<br>● analyse the solutions using a variety of techniques with theoretical and graphical Methods.<br>● explain the behavior of the model.<br>● discuss the validation of the model.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Introduction: General Introduction to Modelling, concepts of system identification, Deterministic vs Stochastic, classification of models.<br>Modelling via First Order Differential Equations:Modelling Through First Order and Simple Higher Order Differential Equations, Linear Differential Equations (LDEs), systems of Ordinary Differential Equations (ODEs).<br>Analysis of Solutions: Existence and uniqueness of solutions, continuation of solutions, dependence on initial conditions and parameters, linear systems of equations with constant and variable coefficients, autonomous systems, phase space, and stability, Interpretation of solutions in modelling.<br>Applications: Population ecology, chemical kinetics, traffic dynamics, Mechanics, Biology and Medicine, Pharmokinetics, Economics, Engineering, Special topics in modelling.</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="4">Lectures, Reading materials, Tutorial discussions</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Semester end Examination : 80%<br>Mid semester Examination : 20%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• Barnes, B., G.. R. Fulford, and Glenn Fulford. Mathematical Modelling with Case Studies. Chapman and Hall/CRC, 2014.<br>• James Sandefur, Elementary Mathematical Modelling: A Dynamic Approach , 1sr Edition, Brooks Cole, 2002.<br>• Kapur, Jagat Narain. Mathematical modelling. New Age International, 1988.<br>• Any Mathematical Modelling Book</td></tr>
</table>

**Applied Mathematics** Level II - Semester I

AMT211β : Classical Mechanics-III (Fluid Dynamics) (30 lecture hrs + 15 tutorial hrs) (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course unit number</td><td rowspan="2">AMT211β</td><td>Course unit Title</td><td colspan="3">Classical Mechanics III(Fluid Dynamics)</td></tr>
<tr><td rowspan="2">Lectures and Tutorials (Hr)</td><td rowspan="2">45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">A/L Combined Mathematics</td></tr>
<tr><td>Credits</td><td>2.5</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="4">The objectives of this course unit is to explain:<br>• basic concepts in Dynamics and applications of Newton’s second law for the motion of a particle and systems of particles.<br>• concepts of fluid dynamics.<br>• kinematics and dynamics of fluid motion.<br>• Flow field around 2D and 3D objects using combination of fundamental potential flow solutions.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">After the successful completion of this course unit, students should be able to<br>• Identify types of fluid flows<br>• distinguish difference between steady/unsteady, uniform/non-uniform, compressible/incompressible flow<br>• describe concepts necessary to analyse fluid motion<br>• identify stream lines, path lines and vortex lines,<br>• use continuity, Euler and Bernoulli equations</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Fluid Dynamics: Types of flows, Equations of stream, path and vortex lines, Equation of continuity, Euler’s and Bernoulli’s equations, Irrotational motion, Uniqueness theorem, Kinetic energy, potential flow, sources and Sinks in 2D and 3D Images, Milne Thompson Theorem</td></tr>
<tr><td colspan="6">Method of teaching and learning: Reading material, Lectures, Problems Solving,</td></tr>
<tr><td colspan="6">Method of Assessment: Continuous assessment:20%<br>Semester End Examination:80%</td></tr>
<tr><td colspan="6">References<br>• Chorlton, Frank. Textbook of fluid dynamics. Van Nostrand Company, 1967.<br>• Green, A. E. Theoretical Hydrodynamics.</td></tr>
</table>

AMT212β: Computational Mathematics (30 lecture hrs + 15 tutorial hrs) (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">AMT212β</td><td>Course Unit Title</td><td colspan="3">Computational Mathematics</td></tr>
<tr><td>Lectures (hrs.)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Tutorial (hrs.)</td><td>15</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit are to provide students with the knowledge and skills tosolve Non-Linear equation by identifying a suitable numerical method, interpolation, and curve fitting for a given data set, anddifferentiation and Integration using numerical methods.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to,<br>• solve non-linear equations using a suitable numerical method.<br>• apply suitable interpolation and curve fitting techniques to fit curves for a given data set.<br>• evaluate derivatives and integrals numerically.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Numerical computing and computers: Introduction, Using a computer to do numerical analysis, Computer arithmetic and errors.<br><br>Solving Non Linear equations: Bisection Method, Newton's Method, Fixed point Iteration $x = g(x)$ Method, Secant Method, Regular-Falsi Method.<br><br>Interpolation and Curve Fitting: Interpolation, Lagrange polynomials, Divided Differences, Interpolating with a Cubic Spline, Least Square Approximation.<br><br>Numerical Differentiation and numerical Integration: Getting derivatives and integrals numerically, Trapezoidal rule (composite formula), Simpson's rules, Applications of cubic splines.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures , Reading materials and Tutorial discussion</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment 20%<br><br>End Semester Examination 80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• P.W. Williams , Numerical Computation<br>• Kendall E. Atkinson, An Introduction To Numerical Analysis</td></tr>
</table>

**Applied Mathematics Level II - Semester II**

AMT221β: Mathematical Modelling-II (30 lecture hrs + 15 tutorial hrs) (Credit Value 2.5)

| | | | | | |
|---|---|---|---|---|---|
| **Course Unit number** | AMT/IMT 221ß | **Course Unit Title** | Mathematical Modelling II | | |
| | | **Lectures (hrs.)** | 30 | **Pre-requisites** | Mathematical Modelling-I (AMT/IMT 121ß) |
| **Credits** | 2 | **Tutorials (hrs.)** | 15 | | |

| | |
|---|---|
| **Course Unit Objectives** | The objectives of this course unit are to give<br>• the ability in modelling the real world problems through ordinary differential equations(ODE), difference equations and partial differential equations(PDE),<br>• the ability of solving ODEs, system of ODEs and PDEs analytically and numerically |
| **Learning Outcomes** | After successful completion of this course, students should be able to<br>• construct mathematical models for real world problems using<br>(iii) ordinary differential equations or systems of differential equations, difference equations<br>(iv) first order linear or quasi linear partial differential equations, second order partial differential equations<br>• solve modelling problems in (i) using different numerical methods<br>• solve modelling problems in (ii) using different analytical methods |
| **Course Content** | Introductory Numerical Solutions of Differential Equations, Mathematical Modelling through Difference Equations, Further Study on Systems of Differential Equations with Matrices. Modelling with Partial Differential Equations (PDEs): The concept of a PDE, Method ofseparation of variables, Mass-Balance equation (The first method of obtaining PDE Models), Momentum-Balance Equation (The second method of obtaining PDE Models), Variational Principles (The third method of obtaining PDE Models), Probability Generating functions (The fourth method of obtaining PDE Models), Nature of PDEs Initial and Boundary Conditions. |
| **Methods of teaching and learning** | Lectures, discussions during the lectures, tutorial discussion. |
| **Method of Assessment** | Continuous assessment -20 %<br>End Semester Examination 80% |

**References**


- Neil Gershenfeld, *The Nature of Mathematical Modeling*, Cambridge University Press, 2011.
- B. Barnes, G.R. Fulford, *Mathematical Modelling with Case Studies: A Differential Equations Approach using Maple and MATLAB*, Second Edition, CRC Press, 2002
- Griffiths**,** David**,** Higham**,** Desmond J., *Numerical Methods for Ordinary Differential Equations -Initial Value Problems*, Springer, Undergraduate Mathematics Series, 2012.
- Walter Strauss, *Introduction to Partial Differential Equations*, 2nd edition, John Wiley & Sons, 2008.

AMT223β: Applied Probability (Information Theory) (30 lecture hrs + 15 tutorial hrs)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">AMT/IMT223β</td><td>Course Unit Title</td><td colspan="3">Applied Probability (Information Theory)</td></tr>
<tr><td>Lectures (hrs.)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2</td><td>Tutorials (hrs.)</td><td>15</td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit are<br>• to learn basic concepts in Information Theory<br>• to gain knowledge on how Probability Theory is used to quantify information and to model a communication channel<br>• to investigate how Information Theory is related to other fields of Science and Mathematics</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to<br>• appreciate the contribution of Information Theory for the development of Information Technology<br>• apply basic techniques, results and concepts in Information Theory to quantify and process information.<br>• understand applications of Information Theory in other fields.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Elementary Probability Theory: discrete and continuous random variables, probability distributions, laws of large numbers, modes of convergence, Markov and Chebyshev inequalities<br>Introduction to Information Theory:Claud E Shannon- the father of information theory, Information measures – entropy, joint entropy, conditional entropy, relative entropy, mutual information. Convex/concave functions, Jensen’s inequality and its consequences, log-sum inequality and its applications, Data processing inequality, Asymptotic equipartition property, how to model a communication channel, Channel capacity, Noiseless Binary Channel, Binary Symmetric Channel<br>Fundamentals of Data Compression: Kraft inequality, Huffman coding.<br>Brief Introduction to Information Geometry: Manifold of probability distributions/densities, Fisher information, exponential family</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures: 30 hrs (2 hrs per week)<br>Tutorial classes: 15 hrs (1 hr per week)</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment: 20%<br>End Semester Examination:80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• Sheldon Ross, A First Course in Probability Theory, Pearson Education, 2002.<br>• David Applebaum, Probability and Information, Cambridge University Press, 1996.</td></tr>
</table>

AMT224β: Applied Statistics-I (30 lecture hrs + 15 tutorial hrs

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">AMT224β /IMT224β</td><td colspan="2">Course Unit Title</td><td colspan="3">Applied Statistics-I</td></tr>
<tr><td colspan="2">Lectures (Hr)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2"></td></tr>
<tr><td>Credits</td><td>2.5</td><td colspan="2">Tutorials (Hr)</td><td>15</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="5">The objective of this course unit is to provide the students the ability to solve some practical problems by statistical methods. It will help students to develop skills in thinking and analyzing problems from a probabilistic and statistical point of view.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the successful completion of this course unit, the students should be able to<br>• explain concepts of probability and statistics.<br>• evaluate various quantities of probability distributions and random variables.<br>• develop probabilistic and statistical models for some applications<br>• apply statistical methods to a range of problems in science, engineering and sociology etc.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="5">Collecting and Summarizing data: Constructing tables and graphs, Measures of center of a set of observations, Median, Arithmetic Mean, Mode.<br>Samples and Populations: Methods of choosing a sample, Measures of variability: Range, Mean<br>deviation, Variance and Standard deviation, Semi-inter quartile range, five number summaries, Box and Whisker plots, stem and leaf plots.<br>Joint distributions of data: The Scatter diagram, the concept of a statistical relation, Quantitative<br>description of a statistical relation, Covariance, Correlation coefficient.<br>Linear regression: Regression equation, Prediction and error, Interpreting regression.<br>Statistical Applications with probability models: Bernoulli, Binomial, Poisson, Normal approximations.</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="5">Lectures , Reading materials and Tutorial discussion</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="5">Continuous assessments 20% and Semester End Written Examination80%</td></tr>
<tr><td colspan="2">References</td><td colspan="5">• Mark L.Berenson, Basic Business Statistics Concept and Applications, (519.5BER).<br>• HarrayJrankan, Steven C.Althoen, Statistics concept and applications, (519.5FRA).<br>• William G. Cochram, Sampling Theory.<br>• Jeffrey L.Bradney, Applied Statistics for Public Administration</td></tr>
</table>

**Applied Mathematics Level III - Semester I**

AMT311β: Numerical Analysis (30 lecture hrs + 15 tutorial hrs); (Credit Value 2.5)

| | | | |
|---|---|---|---|
| **Course Unit number** | AMT 311β | **Course Unit Title** | **Numerical Analysis** |
| | | **Lectures / Tutorials (Hr)** | 45 |
| **Credits** | 2.5 | **Lab (Hr)** | |
| | | **Pre-requisites** | AMT212β |

| | |
|---|---|
| **Objectives** | To provide students with the<br>• skills in problem solving of systems of linear equations with direct methods and numerical methods.<br>• knowledge of convergence criterion of iterative sequences.<br>• knowledge of finding solutions for differential equations (ODE and PDE) numerically. |
| **Learning Outcomes** | On completion of the course unit, the students should be able to<br>• apply the numerical techniques for other Sciences and Engineering in real world problem solving.<br>• determine the most suitable numerical technique with appropriate initial and boundary conditions in problem solving .<br>• compare the solutions obtained using numerical methods with those using analytical methods. |
| **Course Content** | **Solving Linear systems**: Matrix notation, Direct methods, Pivotal and scaling techniques, Gauss and Jordan eliminations, LU decomposition techniques. Iterative Methods - Theorems related to convergence of iterative sequences and convergence criteria, Jacobi, Gauss Seidel, SOR Methods.<br>**Numerical solutions of ordinary differential equations (ODE):**<br>Lipschitz conditions and constants, Picard Iteration technique with applications.<br>Euler (explicit and implicit) and Modified Euler methods, Runge Kutta method.<br>Errors and error propagation. Higher order Taylor expansion for solving ordinary differential equations and Higher order Differential equations.<br>**Numerical solutions of partial differential equations** :<br>Parabolic type, Elliptic type, Hyperbolic type using finite difference methods. |
| **Method of teaching and learning** | Lectures, Reading materials, Tutorial discussions, LMS, Hand outs |
| **Method of Assessment** | Semester End Written Examination : 80%<br>Mid Semester Examination : 20 % |
| **References** | • Atkinson, Kendall and Han, Weimin, Elementary Numerical Analysis, 3rd edition, 2004.<br>• J N. Sharma., Numerical Methods for Engineers and Scientists,2nd edition 2007<br>• John H. Mathews, Numerical Methods for Mathematics, Science and Engineering, 2000 |

AMT312β: Mathematical Modelling III (30 lecture hrs + 15 tutorial hrs); (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">IMT312β</td><td>Course Unit Title</td><td colspan="3">Mathematical Modelling III</td></tr>
<tr><td>Lectures +Tutorial Discussions (hrs.)</td><td>45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>3</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The overall goal of the Mathematical Modelling III is to increase student awareness of the importance of mathematics in the modern world. Variety of modelling techniques that involve differential equations and graph theory will be discussed with examples taken from physics, biology, chemistry, economics and other fields. Laplace transforms as a tool to solve differential equations and basic theory of Graphs will be discussed.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">Upon successful completion of this course, the student will be able to:<br>• solve differential equations using Laplace transforms;<br>• model practical problems that involve differential equations and solve the problems;<br>• demonstrate the basic techniques of graph theory;<br>• apply the graph theory knowledge to solve some network optimization problems.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Solution of Linear Differential Equations by Laplace Transforms, Mathematical Modelling through Graphs, Mathematical Modelling Through Calculus of Variations and Dynamic Programming or Special Topics and/or Project, Stochastic Modelling, A survey on Ancient Sri Lankan Science and Technological Methods, Topics in Mathematical Modelling of Life Environmental relationships.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures, class discussion, tutorial discussion.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment -20%<br>End Semester Examination -80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• Mathematical Modelling, by J.N. Kapur<br>• Graph Theory and Applications , by L.R. Foulds<br>• An Introduction to Differential Equations and Their Applications, by S. J. Farlow</td></tr>
</table>

AMT313β: Mathematical Methods in Physics and Engineering-I (30 lecture hrs + 15 tutorial hrs)

<table>
<tr><td>Course Unit Code</td><td>AMT313β</td><td>Course Unit Title</td><td colspan="3">Mathematical Methods in Physics and Engineering</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Lectures / Tutorials (Hrs)</td><td>Tutorial(Hrs)</td><td>Independent learning (Hrs)</td><td>Pre-requisites</td></tr>
<tr><td>Notional hours</td><td>125</td><td>30</td><td>15</td><td>80</td><td>GCE (A/L) Combined Mathematics</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="4">Objectives of this course unit are to provide students with the knowledge and experience of<br>• Laplace transformations of functions and their applications in Dynamical Systems<br>• Fourier series (FS) approximations of periodic functions.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">At the end of this course unit the students will be able to<br>• Explain conditions for the existence of Laplace Transformation (LT) of a function<br>• Find Laplace Transformations of common functions and prove properties of Laplace Transformation operator.<br>• Find LT of different types of functions.<br>• Find inverse LT (ILT) and study the techniques in finding ILTs of different forms of function.<br>• Apply LTs to solve ODEs and PDEs.<br>• Find Fourier series approximations of periodic functions.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Laplace Transformations, Inverse Laplace transformations, Gamma, Beta and Bessel functions and their Laplace transformations, Applications in solving ODEs and PDEs, Heat and wave functions, Fourier Series.</td></tr>
<tr><td colspan="6">Method of teaching and learning: Teaching:Lectures, class discussion, tutorial discussion.<br>Independent learning: preparation for lectures/tutorials (30hrs), group discussions (10hrs), homework (25hrs), referring library books/Internet sources (15hrs).</td></tr>
<tr><td colspan="6">Method of Asses: Mid semester Tests: 20%<br>Semester End Examination - 80%</td></tr>
<tr><td colspan="6">References:<br>• Laplace Transforms. Murray R. Spiegel,<br>• Integral Transforms, M. D. Raisinghania,<br>• An introduction to Laplace Transforms and Fourier series, Dyke, P.P.G.<br>• Advanced Engineering Mathematics, H. K. Dass</td></tr>
</table>

AMT314β: Applied Statistics-II (30 lecture hrs + 15 tutorial hrs); (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">IMT313β<br>AMT314β</td><td>Course Unit Title</td><td colspan="3">Applied Statistics II</td></tr>
<tr><td>Lectures (hrs.)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">IMT224β<br>AMT224β</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit is to provide the students with the knowledge of hypothesis testing andability of handling non parametric tests.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to<ul><li>identify and apply the suitable parametric test for the real problems.</li><li>apply the relevant non parametric test for the real problems.</li><li>develop the knowledge of decision making based on the test hypothesis and statistical tests.</li></ul></td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Testing Hypothesis about one population mean and two population means<br><br>Testing Hypothesis about many population means:Introduction to analysis of variance, Linear models for analysis of variance, variability as sum of squares, Test statistics and rejection rules<br><br>The population regression: Formulating hypothesis about regression, Analysis of variance for regression<br><br>Non parametric tests: Chi-Square test, Test of independence, Kolmogorov-Smirnov test, Sign test, Mann-Whitney U-test, Runs test (one sample runs test, two sample runs test), Kruskal-Walis test</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Lectures, tutorial, group discussion, problem solving, reading materials</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment - 20%<br>End Semester Examination – 80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4"><ul><li>Basic Statistics and Data Analysis, Larry J. Kitchens</li><li>Introductory statistics, Prem S. Mann</li><li>Applied Statistics and Probability for engineers, Douglas C. Montgomery, George C. Runger</li></ul></td></tr>
</table>

**Applied Mathematics Level III - Semester II**

Refer the Optional course units offered by the department of Mathematics for Level III- Semester II, for details.

**Level III - Semester II The optional course units offered by the Department of Mathematics for level III - Semester II for the 2018-2019 Academic year**

MAT322β: Complex Variables (30 lecture hrs + 15 tutorial hrs), Op. (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">MAT322 β</td><td>Course Unit Title</td><td colspan="3">Complex Variables</td></tr>
<tr><td>Lectures (hrs.)</td><td>30</td><td rowspan="2">Pre-requisites</td><td rowspan="2">None</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit is<br>• introduce students to the Complex Number System<br>• equip students with necessary knowledge and skills to enable them to han involving complex numbers and functions.<br>• provide students with tools for integrating complex functions that help evaluate definite integrals of functions which are difficult to integrate.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to<br>• define a function of complex variable and carry out basic mathematical operations with complex numbers.<br>• explain the concept of transformation in a complex space (linear and non-linear) and sketch associated diagrams.<br>• discuss the condition(s) for a complex variable function to be differentiable, analytic and/or harmonic.<br>• integrate complex functions on simple closed contours using various theorems and use those complex integrals to find out difficult to evaluate definite integrals of real functions.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">Introduction to complex numbers, Complex functions, Differentiation of complex functions, Cauchy-Riemann equations, Analytic functions, Cauchy’s theorem, Cauchy’s integral formula, Extension of Cauchy’s integral formula for finding derivatives of complex functions, Taylor’s and Laurent’s series, Classification of Singular points of complex functions, Residue of a complex function, Cauchy’s Residue theorem, Integration of rational and trigonometric functions on real line using residue theorem</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Through lectures and tutorial discussions.</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment 20%<br>End Semester Examination 80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">• Theory and problems of complex variables with an introduction to conformal mapping and its applications by Spiegel, Murray R.<br>• A guide to complex variables by Krantz, Steven G.</td></tr>
</table>

MAT324β: Mathematical Models in Ecology (30 lecture hrs + 15 tutorial hrs), Op. (Credit Value 2.5)

| | | | | | |
|---|---|---|---|---|---|
| **Course Unit number** | MAT324β | **Course Unit Title** | Mathematical Models in Ecology | | |
| | | **Lectures (Hr)** | 30 | **GPA/NGPA** | GPA |
| **Credits** | 2.5 | **Tutorials (Hr)** | 15 | | |
| **Objectives** | The objectives of this course unit are to provide students a knowledge<br>• about dynamical systems<br>• how to find equilibrium states of a dynamical system<br>• about web analysis of a dynamical system<br>• about population dynamics | | | | |
| **Learning Outcomes** | After successfully completing this course, students will be able to<br>• Apply the knowledge on linear and nonlinear Dynamical Systems to solve mathematical problems<br>• Find the stability of the equilibrium points of dynamical systems<br>• Solve problems on population dynamics | | | | |
| **Course Content** | • Introduction to Modelling: Basic description of mathematical modelling, Introduction to Dynamical Systems, Ecological Models.<br>• Linear Dynamical Systems: Analysis of Dynamical systems, Equilibrium, Stability, Ratios and Proportional Change.<br>• Nonlinear Dynamical Systems: Introduction, Stability, Web Analysis.<br>• Population Dynamics: Introduction to population Growth, Logistic Model, Nonlinear Growth Rates, Graphical Approach to Harvesting, Analytic Approach to Harvesting, Economics of Harvesting. | | | | |
| **Method of teaching and learning** | Conducting Lecture and Tutorial classes | | | | |
| **Method of Assessment** | Mid semester examination – 20%<br>Endsemester examination– 80% | | | | |
| **References** | Mathematical Modelling in Ecology: A Workbook for Students, Jeffries, C., 1989 | | | | |

MAT327β:Introduction to Financial Mathematics (30 lecture hrs + 15 tutorial hrs) (Credit Value 2.5)

| | | | | | |
|---|---|---|---|---|---|
| **Course Unit Code** | MAT 327$\beta$ | **Course Unit Title** | **Introduction to Financial Mathematics** | | |
| | | **Lectures (Hr)** | 45 | **Pre-requisites** | |
| **Credits** | 2.5 | **Lab (Hr)** | | | |

| | |
|---|---|
| **Objectives** | The objective of this course unit are to<br>• enhance the basic knowledge of traditional material in interest theory.<br>• give deep understanding of annuities, loan repayment, bonds<br>• provide some ideas of Asset Liability Management.<br>• discuss some real world applications of these financial instruments. |
| **Learning Outcomes** | After successfully completing this course students should be able to<br>• distinguish different types of interest rates that can be used in real world problems<br>• calculate annuities and bond prices and apply these concepts in real applications<br>• identify possible methods in loan repayment and their applications<br>• explain concepts like duration, convexity and immunization and apply them in asset liability management. |
| **Course Content** | **Introduction**: Time Value of Money, Compound Interest, Simple Interest, Present Value, Future Value, Accumulation Function, Discount Rate, Continuous Interest, Force of Interest, and Equation of Value.<br>**Annuities**: Immediate, Due, Time Lines, Perpetuities, Continuous Annuities, Variable Annuities, and Reinvestment Problems.<br>**Loan Repayment**: Amortization, Prospective/Retrospective Methods, Instalment Loan, Sinking Funds, Net Interest, and Capitalization of Interest.<br>**Bonds**: Face value, Par value, Coupon rate, Redemption Value, Bond Price, Makeham's Formula, Amortization of Premium/Discount, Callable Bond, Price-Plus Accrued, Market Price, and True Price.<br>**Yield Structure of Interest Rate**: Internal Rate of Return, Cash Flows, Borrowing Projects, Time/Dollar Weighted Rates, Portfolio Method, and Net Present Value.<br>**Term Structure Interest Rates**: Term Structure of Interest Rates, Risk Free Rates, Yield Curve, and Forward Rate.<br>**Asset Liability Management, Duration and Immunization**: Assets, Liabilities Management, Duration, Convexity, Immunization, Stocks, Dividends, and Mutual Funds. |
| **Method of teaching and learning** | Lectures and Practical sessions |
| **Method of Assessment** | Continuous assessment -20%<br>End Semester Examination -80% |
| **References** | Actuarial Mathematics, Newton L. Bowers, JR, Hans U Gerber, James C Hickman, Donald A Jones, Cecil J Nesbitt, The Society of Actuaries, 1993<br>Models for Quantifying Risk, Second Edition, Robin Cunningham, Thomas Herzog, Richard L. London |

IMT321β: Applied Algebra (Algebraic Data Encryption & Decryption Methods) (30 lec- ture hrs + 15 tutorial hrs), (Credit Value 2.5)

<table>
<tr><td rowspan="2">Course Unit number</td><td rowspan="2">IMT 321β</td><td>Course Unit Title</td><td colspan="3">Applied Algebra (Algebraic Data Encryption and Decryption Methods)</td></tr>
<tr><td>Lectures (hrs.)</td><td>45</td><td rowspan="2">Pre-requisites</td><td rowspan="2">MAT111β, MAT211β,MAT221β</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Practical (hrs.)</td><td></td></tr>
<tr><td colspan="2">Course Unit Objectives</td><td colspan="4">The objectives of this course unit isto introduce applications of pure mathematics particularly Algebra and Number Theory to real world problems such as cryptography and coding theory</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">On completion of the course unit, students should be able to<br>• explain basic cryptographic systems and mathematics behind them.<br>• identify basic ideas for communication channels and data transmission<br>• describe basic notions such as the notion of distance, error detection, error correction, decoding and encoding.<br>• make use of some notions and results in the theory of finite fields fundamental to the theory of linear codes.<br>• use some preliminary facts from the theory of vector spaces and matrices over finite fields to describe linear codes as well as the generator and parity check matrices and to identify the concept of syndrome for decoding.<br>• identify Hamming, Golay, cyclic, BCH and Reed-Solomon codes.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">RSA Encryption Scheme: Raising integers to large powers to a given modulus, 'Egyptian exponentiation', Discussion of primality testing, The Little Fermat and Rabin tests, Implications for the RSA system, Verifying authenticity<br>Topics in Rings and Fields: GF(p), Polynomials over a ring, The Primitive Element Theorem, RecurrentSequences, shift registers, The ideal and minimal polynomial of a sequence, Indexing polynomials. Congruence modulo a polynomial, Construction of Finite Fields, Construction of indexing polynomials, Cyclotomic polynomials, Factorizing polynomials over Finite Fields<br>Error detection and correction in telecommunication: ISBN codes, The Hamming metric, The minimum distance of a code, Elementary bounds on the minimum distance of a code, Equivalence of codes, Parity checks,The sphere-packing bound, Reed-Muller codes, Linear Codes, Dual codes, The parity check matrix of a linear code, Syndrome decoding, The Hamming codes, Cyclic Codes, Generator polynomials and check polynomials, Construction of binary Hamming codes as cyclic codes, The BCH codes, Golay code.</td></tr>
<tr><td colspan="2">Methods of teaching and learning</td><td colspan="4">Reading material, Lectures, Tutorial Classes, Discussion, Videos</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">Continuous assessment -20%<br>End Semester Examination -80%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">● Introduction to finite fields and their applications, Rudolf Lidl and Harald Niederreiter<br>● A First course in coding theory, Richard Hill,<br>● Coding theory. A first course, San Ling & Chaoping Xing,<br>● Error-correcting codes, Franz Lemmermeyer<br>● Modern Cryptography- Applied Mathematics forEncryption and Information Security, Chuck Easttom</td></tr>
</table>

IMT324β: Statistics with Computer Applications (30 lecture hrs + 15 tutorial hrs), Pre- requisite MAT225β,MAT313β ,AMT314β, IMT313β Op.

<table>
<tr><td rowspan="2">Course Unit Code</td><td rowspan="2">IMT324β</td><td>Course Unit Title</td><td colspan="3">Statistics with Computer Applications</td></tr>
<tr><td>Lectures (Hr)</td><td>15</td><td rowspan="2">Pre-requisites</td><td rowspan="2">MAT225β , AMT314 or IMT313 β</td></tr>
<tr><td>Credits</td><td>2.5</td><td>Lab (Hr)</td><td>30</td></tr>
<tr><td colspan="2">Objectives</td><td colspan="4">The objectives of this course unit are to introduce and explain the important ideas in practical statistics, so that students will<br>• know when to apply various statistical methods,<br>• understand the associated problems and pitfalls</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="4">After completing this course unit successfully, students should be able to:<br>• suggest methods to obtain relevant data,<br>• summarize low-dimensional data sets, both graphically and numerically and<br>• identify the pattern of the given data set and apply the statistical techniques according to that, for a given practical problem.</td></tr>
<tr><td colspan="2">Course Content</td><td colspan="4">The following statistical problems will be solved with computers software:<br>• summarizing data (univariate, bivariate and multivariate)<br>• analysing one sample, two samples and more than two samples data sets.<br>• linear Regression and correlation.<br>• analysis of Categorical Data: Goodness-of-fit test, Test of independence, Test of homogeneity.</td></tr>
<tr><td colspan="2">Method of teaching and learning</td><td colspan="4">Lectures and Practical sessions</td></tr>
<tr><td colspan="2">Method of Assessment</td><td colspan="4">End of semester practical Examination : 100%</td></tr>
<tr><td colspan="2">References</td><td colspan="4">Basic Statistics and Data Analysis, Larry J. Kitchens</td></tr>
</table>