**Semester 1**

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| Learning Outcomes: |
| *On successful completion of this module the learner will be able to* |
| 1. Manipulate and solve simple algebraic expressions and equations. 2. Manipulate and solve some special types of algebraic and trigonometric expressions/equations. 3. Apply the basic techniques of trigonometry to solve problems in Engineering. 4. Find the equation of a straight line through data. Extrapolate and interpolate. Find the centre and radius of a circle. Convert from Cartesian to polar form in 2D. 5. Perform algebra using complex numbers. |

## Module Content & Assessment

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| Content |
| * **Algebra** * Laws of indices (With scientific units and scientific notation). Precedence rules. Multiplication and simple factorisation. Fractions and algebraic fractions. Transposition of formulae. Solution of quadratic and linear equations. * **Further Algebra** * Simultaneous equations (linear+linear, linear+circle). Solving linear inequalities. Completing the square (to factorize and solve quadratics). * **Trigonometry** * Right-angled triangles. Sin, cos and tan. Sin, cos and tan as lengths in the unit circle. Pythagoras’ theorem. Solution of right-angled triangles. Sine and cosine rules. Solution of simple trigonometric equations. Trigonometric formulae. Degree to radian conversion. Graphs of trigonometric functions Applications of trigonometry to problems in Electronic Engineering: Signal frequency, amplitude, phase. * **Coordinate geometry** * Equation of straight line through data. Plotting simple linear laws, y-intercept and slope. Distance in 2D.Equation of circle. Polar coordinates in 2D. * **Complex numbers** * Argand/Phasor diagram. Addition, subtraction, multiplication and division of complex numbers. Polar form. Exponential form. Eulers fromula. De Moivre’s theorem. Application to complex impedance in RLC circuits. |

**Semester 2**

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| Learning Outcomes: |
| *On successful completion of this module the learner will be able to* |
| 1. Graph functions, identify 1-1 functions,apply the algebra of functions, , logs and exponential functions. 2. Apply the standard techniques of differential calculus. 3. Apply the differential calculus to simple 1 variable problems in engineering. 4. Do integration of simple engineering functions. 5. Do calculations with vectors and matrices apply them to simple problems in engineering. |

## Module Content & Assessment

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| Content |
| * **Functions and their graphs** * Basic concepts. Domain and range. Graphs of functions.Graphs of continuous and smooth functions. 1-1 and onto functions. Function inverse. Algebra of functions. Engineering functions: Polynomials. Rational functions. Periodic functions. Natural log and exponential functions. Engineering functions on the calculator. Solving equations involving natural log and exponential functions. Fitting exponential data using a log-linear plot. * **Differentiation** * Average and instantaneous rate of change. Geometric interpretation of the derivative. Differentiation of engineering functions. Linearity rules. Product, quotient and chain rules. Second derivative. Applications of differentiation: Max/min problems for polynomial examples. Rates of change. Velocity and acceleration. Current and voltage. Error analysis in 1D. * **Integration** * Introduction to integration. Integration of engineering functions.Linearity. Integration of a derivative. Substitution of simple linear variables and corresponding change of limits. Area under a curve. * **Vectors and matrices** * Examples of vectors. Addition and subtraction of column vectors. Modulus of a vector. Unit vectors. Scalar product. Resolution. 2D transformations (shear, rotation, dilation). Composition of transformations. Introduction to 2D matrices as transformations. Matrix algebra. Transformation/Matrix inverse. Introduction to Matrix algebra. Algebra of matrices (addition and multiplication) up to and including matrices of order 3, including matrices with complex entries. Determinants, cofactors, inverses. Solution of equations using matrix inversion. Applications to Electronic Engineering. |

**Semester 3**

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| Learning Outcomes: |
| *On successful completion of this module the learner will be able to* |
| 1. Collect, present and summarise data. 2. Apply probability theory to problems in reliability engineering, sampling inspection, conformance to specification and failure times. 3. Use hypothesis tests to compare products or processes. 4. Use confidence intervals to infer values of variables and proportions. |

## Module Content & Assessment

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| Content |
| * **Data** * Organising data: frequency tables. Graphs: frequency curves, and time series. Population and sample: inference. Summary statistics: mean, median, mode, range, standard deviation, coefficient of variation. * **Probability** * Calculating probabilities. Permutations and combinations. The laws of probability. Reliability engineering: components in series and in parallel. * **Distributions** * The binomial distribution: defectives. The Poisson distribution: defects,breakdowns. The exponential distribution: failure times. The normal distribution: percentage out-of-specification. Typical non-normal patterns and their causes. * **Estimation** * Statistical tolerancing. The central limit theorem, the addition of variances. Statistical tolerancing. The central limit theorem. Confidence intervals for means and proportions. * **Hypothesis Testing** * Tests of population means and proportions. z, t and chisquare tests. |

**Semester 4**

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| Learning Outcomes: |
| *On successful completion of this module the learner will be able to* |
| 1. Calculate integrals using a range of integration techniques, including integrals involving Sinusoidal Oscillations, Piecewise linear signals and odd and even signals. 2. Calculate and invert Laplace transforms for standard functions. Write Transfer functions in standard form, calculate poles and zeros. Calculate Transfer function from poles and zeros. Apply Routh Criterion for stability to Transfer functions for second and third order stability problems. 3. Solve simple differential equations associated with circuits using Laplace transforms. 4. Interpret and manipulate matrix expressions, and use matrices for the solution of linear equations. Use matrices to determine stability in 2nd and 3rd order stability problems in Electronic Engineering via the Hurwiz criterion. 5. Calculate limits, sum geometric series and test series for convergence. |

## Module Content & Assessment

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| Content |
| * **Techniques of Integration** * Basic rules; integration by substitution; integration by parts. The method of partial fractions, Applications of integration to Fourier coefficients, area and work done. Signals and integration: Sinusoidal Oscillations, Piecewise linear signals, even and odd signals. Time domain and frequency domain. * **Laplace Transforms** * Introduction. Transforms of standard functions. Inverse transforms. Table of inverse transforms. Transfer functions, writing them in standard form, finding poles and zeros. Routh Criterion for stability. Differential equations for RC, LC and LRC circuits with DC and AC sources. Solution of first order linear ODEs with constant coefficients by Laplace transform method. The Laplace transform of a second order linear ODE with constant coefficients. * **Matrices** * Algebra of matrices, including matrices with complex entries. Inverse of a matrix. Determinants. Simultaneous linear equations Gaussian elimination Uniqueness of solutions. Applications to second and third order stability problems in Electronic Engineering via the Hurwiz criterion. * **Sequences and Series** * Definitions. Geometric progressions. Summing series, limits and convergence. Ratio test for convergence. |

**Semester 1 - Resources**

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| Resources |
| *Required Book Resources* |
| * **Kuldeep Singh 2003, *Engineering mathematics through applications*, Palgrave MacMilan [ISBN: 0-333-92224-7]** |
| *Recommended Book Resources* |
| * **K. A. Stroud 1987, *Engineering mathematics*, 4th ed Ed., Macmillan London [ISBN: 0333 - 62022 – 4]** * **L. R. Mustoe, M. D. J. Barry 1998, *Foundation mathematics*, J. Wiley Chichester [ISBN: 0-471-97092-1]** * **A. Croft and R. Davison, *Mathematics for Engineers – A Modern Interactive Approach*, 2nd ed Ed., Prentice Hall [ISBN: 0-131-20193]** |

**Semester 2 - Resources**

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| Resources |
| *Required Book Resources* |
| * **Dexter J. Booth,, *Engineering Mathematics* [ISBN: 9781403942463]** |
| *Recommended Book Resources* |
| * **Kuldeep Singh 2003, *Engineering mathematics through applications*, Industrial Press New York [ISBN: 0333922247]** |

**Semester 3 - Resources**

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| Resources |
| *Required Book Resources* |
| * **James Reilly, 2006, *Using Statistics*, Gill and Macmillan [ISBN: 978-0717140220]** |
| *Recommended Book Resources* |
| * **Reilly, J. 1997, *Understanding Statistics*, Folens** |

**Semester 4 - Resources**

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| Resources |
| *Required Book Resources* |
| * **Dexter J. Booth,, *Engineering Mathematics* [ISBN: 9781403942463]** |
| *Recommended Book Resources* |
| * **Kuldeep Singh, *Engineering mathematics through applications*, Palgrave Macmillan Basingstoke [ISBN: 0333922247]** |