UNIT TITLE:	**Further Mathematics for Engineers**
LEVEL:	**THREE**
CREDIT VALUE:	**6**
UNIT CODE:	**WJF981**
UNIT TYPE:	**Ungraded**

(Access/A2 – revised May 2017)

This unit has 3 learning outcomes.

LEARNING OUTCOMES	**ASSESSMENT CRITERIA**
The learner will:	**The learner can[1]:**
1. Be able to apply statistical and probability techniques to solve engineering problems.	1.1 Use routine statistical operations involving data and frequency distributions, presenting data via histograms, bar and pie charts. 1.2 Explain statistical measurement and the terms used. 1.3 Illustrate the linear relationship between independent and dependent variables and the use of scatter diagrams. 1.4 Use probability distributions, routine and non-routine operations to solve engineering problems.
2. Understand how differential calculus can be used to solve engineering problems.	2.1 Explain the primary functions of differential calculus in engineering and the importance of functions, rate of change and gradient in the process. 2.2 Describe the principal methods of differentiation and perform calculations based on these principles.
3. Be able to demonstrate how integral calculus can be used to solve engineering problems.	3.1 Explain how integration can be seen as the reverse/inverse of differentiation and the types of routine and non-routine functions involved in the process. 3.2 Consider the use of integration as a summating tool and its use in engineering applications. 3.3 Use numerical integration to solve engineering problems.

[1] Insert additional rows if more Assessment Criteria are required to evidence a Learning Outcome

Indicative Content[2]:

1. Be able to apply statistical and probability techniques to solve engineering problems.

1.1 Discrete, continuous, grouped and ungrouped data, rogue values. Presentation of data using bar and pie charts, histograms and cumulative frequency curves. Use of tally charts, upper and lower limits, class boundaries, class width.

1.2 Measures of value location: arithmetic mean, median, mode. Measures of dispersion: variance, mean and standard deviation, range and inter-percentile range. Statistical averages and variance.

1.3 Linear relationship between independent variables, scatter diagrams and the equation of line of regression, $y = mx + c$, represented graphically.

1.4 Routine operations: shape and symmetry, skew, tables of the cumulative distribution function, mean and variance. Non-routine operations: confidence intervals for normal distribution and probability calculations. Application to engineering problems: inspection and quality assurance of production operations, product performance, forecasting, estimating reliability for components and systems, customer behaviour.

2. Understand how differential calculus can be used to solve engineering problems

2.1 Use of differential calculus to calculate change with respect to variables such as time, distance or speed. Functions, many-one and one-one mapping.

2.2 The gradient of a curve and graphical differentiation, Leibniz and engineering notation, differentiation, the second derivative, rate of change and turning points, differentiation of simple trigonometric and exponential functions. Engineering applications: velocity/acceleration of a moving object, heat flow, radioactive decay cutting tool life, hydraulic flow rates, minimising production costs, resistance matching in electrical power circuits to achieve maximum power transfer.

3. Be able to demonstrate how integral calculus can be used to solve engineering problems

3.1 Integral calculus used to find the length of arcs, surface areas or volumes of non-standard shapes and to operate as the inverse of differential calculus (anti-differentiation), the summing process, finding the whole from its parts. Symbolic representation, algebraic expressions and the constant of integration. Types of function: polynomial, trigonometric (sine and cosine), reciprocal and exponential. Routine functions, integration in one step, little engineering application. Non-routine functions requiring manipulation, indefinite integrals, definite integrals, integration by substitution and by parts.

3.2 Use as a summating tool, area under a curve from first principles, strip theory. Area under a curve as a summation between the limits applied to the function. Mean value and root mean square (RMS) value of periodic functions. Engineering applications, work done, distance travelled, mean and RMS values of waveforms in electrical circuits.

3.3 Numerical integration: trapezoidal, mid-ordinate and Simpson's rule. Area under a curve obtained by integrating its function. Numerical integration using a spreadsheet. Engineering applications: determination of mechanical, electrical and thermal energy.

[2] Provide guidance in terms of recommended curriculum content

Recommended Assessment Method (s)[3]:

Methodology	Insert √	Methodology	Insert √
Essay		Tutor Observation	
Presentation		Experiment	
Report		Practical Demonstration	
Exam	√	Other (provide details in additional details box)	

Additional Details:

For university entry, assessment by unseen examinations is preferred and the learner will be expected to know basic formulae.

Indicative reading:[4]

1. TOOLY, M and DINGLE, L (2010) *BTEC National Engineering*. 3rd Ed. Newnes.
2. STROUD, K.A. and BOOTH, D.J. (2013) *Engineering Mathematics*. 7th Ed. Palgrave Macmillan.
3. http://www.mathcentre.ac.uk
4. http://www.mathtutor.ac.uk

[3] One or more of these methods may be employed in evidencing the Learning Outcomes and Assessment Criteria for the unit. However, please note that these methods do not preclude other means of evidencing Learning Outcomes and Assessment Criteria and are only **RECOMMENDED** means of assessment

[4] Please add key URLs and/or key texts/articles for the unit