19.2.0 ENGINEERING MATHEMATICS II

19.2.01 Introduction

This module unit is designed to equip the trainee with the knowledge, skills and attitudes to apply Mathematical skills in their trade area.

The trainee will use Advanced Mathematical tables and non-programmable scientific calculator. Suggested teaching/learning activities and resources, and evaluation methods are listed at the end of the unit.

19.2.02 General Objectives

At the end of this module unit, the trainee should be able to: -

a) Understand mathematical techniques relevant to electrical engineering
b) Apply mathematical techniques relevant to electrical engineering
c) Appreciate the role of Mathematics in everyday life

19.2.03 Module Unit Summary and Time Allocation

Engineering Mathematics II

Code	Sub-Module Unit	Content	HRS
19.2.1	Vector Theory I	• Vector algebra and theorems • Dot and Cross products • Gradient, Divergence and Curl operators • Application	10
19.2.2	Matrices I	• Matrix operations • Determinants • Inverse of 3x3 matrix • Solution of simultaneous equations	8
19.2.3	Ordinary Differential Equations	• Formation and solution of 1^{st} differential equations • 2^{nd} order linear differential equations with constant coefficient • D-operator • Series solutions • Application of ordinary differential equation	10

19.2.4	Partial Differentiation	• Definition of partial derivatives • Derivation of a function of two or more variables • Problem solving • Stationary points of functions of two variables	8
19.2.5	Laplace transforms	• Definition • Properties of Laplace transforms • Inverse transforms • Application of Taylor's theorem to obtain power series • Use of Maclaurin's theorem to obtain power series • Application of Taylor's theorem in numerical work.	10
19.2.6	Power series	• Definition of power series • Taylor's Theorem • Maclaurin's theorem • Application of Taylor's theorem • Application of Maclaurin's theorem • Application of Maclaurin's theorem in numerical work.	6
19.2.7	Statistics	• Data organization and presentation • Measures of central tendencies • Measures of dispersion • Skewness • Coefficient of skewness • Regression lines • Correlation and regression	6
19.2.8	Probability	• Definition • Laws of probability • Probability distribution • Mathematical expectation • Sampling distribution	6
Total Time			64

19.2.1 **VECTOR S THEORY I**

Theory

19.2.1T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should able to:
a) define vector theorems
b) solve problems involving the dot and cross products.
c) define gradient, divergence and curl operators
d) solve problems involving gradient, divergence and curl operators.

Content

19.2.1T1 Definition of a vector and scalar

19.2.1T2 Distinguish between vector and scalar quantities

19.2.1T3 Vector theorems
i) Resolution of vector
ii) Proof of the Ratio theorem
iii) Use of the Ratio theorem
iv) Dot and cross products

19.2.1T4 Problems involving dot and cross products of vector

19.2.1T5 Definition of the operators gradient, divergence and curl

19.2.1T6 Problems involving gradient, divergence and curl operators

19.2.2 MATRICES I

19.2.2T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
a) perform matrix operations
b) determine the determinant of a 3x3 matrix using co-factor method and Sirus rule.
c) determine the inverse of a 3x3 matrix
d) apply matrices in solving linear simultaneous equations in 3 unknowns.

Content

19.2.2T1 Performing matrix operation

19.2.2T2 Determination of the determinant of a 3x3 matrix using:
i) Co-factor method
ii) Sirus Rule

19.2.2T3 Determination of the inverse of a 3x3 matrix
i) Adjoint and determinant
ii) Augmented matrix and row reduction

19.2.2T4 Solution of linear simultaneous equations in 3 unknowns.

19.2.3 **ORDINARY DIFFERENTIAL EQUATIONS**

Theory

19.2.3T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
a) Form and solve 1st order differential equation
b) form and solve 2nd order linear ordinary differential equations
c) apply the D- operator method to solve differential equations
d) apply 1st order and 2nd order linear differential equations in electrical problems.

Content

19.2.3T1 Formation of 1st order linear differential equations

19.2.3T2 Solution of differential equations
i) 1st order variable separable
ii) 1st order homogenous
iii) 1st order linear

19.2.3T3 2nd order by the method of determination of coefficients

19.2.3T4 solution to 2nd order differential equations

19.2.3T5 D-operator method
i) Simultaneous differential equations
ii) Series method

19.2.3T6 Application of differential equations
i) Control systems
ii) R-L-C circuits

19.2.4 **PARTIAL DIFFERENTIATION**

Theory

19.2.4T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
a) define partial derivative of a function of two variables.
b) differentiate a function of two variables or more.
c) solve problems involving small changes or errors using partial derivatives.
d) find stationary points of functions of two variables.

Content

19.2.4T1 Definition of partial derivatives of two variables.

19.2.4T2 Differentiation of a function of two variables or more.

19.2.4T3 Solution of problems involving small changes using partial derivatives.

19.2.4T4 Finding stationary points of functions of two variables.

19.2.5 **LAPLACE TRANSFORMS**

Theory

19.2.5T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should able to:

a) define the Laplace transform of a function
b) use simple properties of Laplace transforms
c) determine the inverse Laplace transforms of simple forms using partial fractions
d) use Laplace transforms to solve ordinary differential equations and simultaneous differential equations with constant coefficients and given initial conditions.
e) Apply Laplace transforms in electrical engineering

Content

19.2.5T1 Definition of the Laplace transform of a function

i) Deriving the Laplace transforms of simple functions
ii) Laplace transform of elementary functions
iii) Inference of linearity properties
iv) Use of list of standard transforms

19.2.5TT2 Using simple properties of Laplace transforms

i) Derivations of Laplace transforms of F(t) e-at
ii) Statement of initial and final value theorems for simple
iii) Derivation of the Laplace transforms of the first and second derivatives from definition.

19.2.5T3 Determination of the inverse Laplace transforms of simple transforms using a list of transforms and partial fractions.

i) Definition of inverse Laplace transform
ii) Determination of inverse Laplace transforms of simple forms using a list of standard forms.
iii) Determination of partial fractions for expressions up to degree three in the denominator including cases of linear and quadratic repeated factors.
iv) Determination of inverse Laplace transforms of forms using partial fractions and a list of standard transforms.

19.2.5T4 Using Laplace transforms to solve:

i) Differential equations and simultaneous

equations with constant coefficients and given initial conditions.

ii) Application of theorem for the Lap lace transforms

iii) Evaluations of Laplace transform using a small stock of transform key pair

$$e^{-xt}H(t) = \frac{1}{P+X} - \mathrm{Re}^{x}\,\mathrm{Re}\,p$$

iv) Application of Laplace transforms to impulse response problems.
- Using transfer transforms.
- Setting out initial value problems.

v) Application of Laplace transforms to switching problems.

Suggested teaching/Learning Resources
- Laplace transform reference table

19.2.6 POWER SERIES

19.2.6T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
a) explain the term power series.
b) state Taylor's theorem without reminder.
c) deduce Maclaurin's theorem form Taylor's theorem.
d) apply Taylors's theorem to obtain power series
e) apply Maclaurin's theorem to obtain power series
f) apply Maclaurin's theorem in numerical work.

Content

19.2.6T1 Explanation of the term power series.

19.2.6T2 Statement of Taylor's Theorem.

19.2.6T3 Deduction of Maclaurin's theorem from Taylor's theorem.

19.2.6T4 Application of Taylor's theorem to obtain power series

19.2.6T5 Use of Maclaurin's theorem to obtain power series.

19.2.6T6 Application of Taylor's theorem in numerical work.

19.2.6T7 Application of Maclaurin's theorem in numerical work.

19.2.8 STATISTICS

Theory

19.2.8T0 *Specific Objectives*
By the end of the sub - module unit, the trainee should be able to:
a) Organize and present data coefficient

b) determine measures of central tendencies for data
c) determine measures of dispersion
d) define skewness
e) determine the coefficient of skewness
f) define regression lines
g) define correlation coefficients

Content

19.2.8T1 Data organisation
i) Frequency distributions and diagrams
ii) Grouped and ungrouped

19.2.8T2 Determination of measures of central tendencies
i) Mean
ii) Median
iii) Mode

19.2.8T3 Measures of dispersion
i) Range
ii) Mean
iii) Deviations
iv) Variance
v) Standard deviation

19.2.8T4 Definition of skewness
- Pearson's coefficient of skewness

19.2.8T5 Coefficient of skewness
i) Negative
ii) Zero
iii) Positive

19.2.8T6 Definition of regression lines

19.2.8T7 Definition of correlation coefficients
- Calculation of regression lines
- Calculation of correlation

19.2.9 PROBABILITY

Theory

19.2.9T0 *Specific Objectives*
By the end of the sub - module unit, the trainee should be able to:
a) define concept of probability
b) identify various types of events
c) state laws of probability
d) describe types of data distribution
e) define Theorems of Mathematical expectations
f) describe sampling methods

Content

19.2.9T1 Probability random variable

19.2.9T2 Types of events

19.2.9T3 Laws of probability

19.2.9T3 Theorems on expectation

19.2.9T4 Types of data distributions
i) Poisson distribution
ii) Binomial distribution
iii) Continuous distributions
iv) Normal distribution
v) T-distribution
vi) Chi-Square distribution
vii) Interpretation of their tables

viii) Application of various distribution methods
ix) confidence limits of mean and difference of means
x) Tests of hypothesis
xi) Goodness of fit

19.2.9T5 Sampling methods
i) Sampling distribution
ii) Applications

Suggested teaching/Learning Activities

- Discussion
- Illustration
- Demonstration

Suggested teaching/Learning Resources

- Advanced Mathematical tables
- Scientific calculator

Suggested Evaluation Methods

- Oral tests
- Timed written tests
- Assignments