DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

POWER OPTION

MODULE III

MODULE III – INDUSTRIAL MACHINES AND CONTROLS

Introduction

Module III is designed for all trainees who meet the entry requirements for the Diploma in Electrical Engineering Module III which include the completion of Module II or any other equivalent and approved course. The Module is intended to impart knowledge skills and attitudes that will meet the needs of the industry in the areas of electrical installation design, repair, maintenance and servicing of microprocessor systems.

The trainees are also expected to acquire generic skills which will make them adapt to the dynamic world of work.

General Objectives

At the end of Module, the trainee should be able to:

a) Understand the concepts of Electrical and electronic systems
b) Carry out electrical installations design
c) Maintain electrical installation systems, micro controllers, power systems, machines and electronic equipment
d) Estimate, tender and supervise Electrical and Electronic works
e) Understand the management and of industrial organizations and other institutions.
f) Analyse and maintain overhead power transmission lines.

Key Competence

At the end of Module, the trainee should have the ability to:

i) Install, service and maintain micro controllers
ii) Estimate and tender for electrical services
iii) Manage electrical power generation, transmission and distribution lines
iv) Install, service and maintain electrical machines and machine controls

The units covered in this module are:

Code	Module Unit
27.3.0	Engineering Mathematics III
28.3.0	Microcontroller Technology
29.3.0	Industrial Organisation and Management
30.3.0	Microprocessor Systems
31.3.0	Estimating, Tendering and Engineering Service Contracts
32.3.0	Trade Project
33.3.0	Electromagnetic Fields Theory
34.3.0	Machines and utilisation
35.3.0	Electrical Power Transmission and Distribution
36.3.0	Power Electronics

27.3 0 **ENGINEERING MATHEMATICS III**

27.3 0 1 **Introduction**

This module unit is designed with knowledge, skills and attitudes needed by the trainee in order to enhance his performance in other analytical areas of study in his trade and at the same time acquire a firm foundation for further training.

The trainee will need Advanced Mathematical tables and non-programmable scientific calculator. At the end of this unit is a list of Suggested teaching/learning activities, resources, and evaluation methods suitable for the unit. The list is not exhaustive and the trainers may explore other suitable methods.

27.3.02 **General Objectives**

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

a) Understand mathematical techniques relevant to electrical and electronic engineering trade.
b) Apply mathematical techniques in the trade and in every day life.

27.3.03 **Module Unit Summary and Time Allocation**

Engineering Mathematics III

Code	Sub-Module Unit	Content	Time Hrs
27.3.1	Fourier Series	• Definition of Fourier series • Determination of Fourier series for period 2π to T • Fourier series for odd and even functions • Numerical harmonics	14
27.3.2	Multiple integrals	• Definition of multiple integrals • Determination of areas and volumes using double angle integrals • Application of double integrals in polar and cylindrical coordinates • Solution of problems using triple integrals	16
27.3.3	Vector Theory II	• The Green's theorem • Application of Green's theorem • Statement of two distinct but closely related physical interpretation of Green's theorem • Extension of Green's theorem to Stoke's theorem	24

		• Application of Stoke's theorem • Application of Stoke's theorem • Application of Guss's Theorem • Extension of Green's theorem to Gauss's theorem; • Application of Gauss's theorem • Definition of conservative vector fields • Application of conservative vector fields • Use of surface integrals • Application of surface integrals • Statement of Maxwell's equation in the modern analysis using divergence and curl. • Definition of Pointing Theorem • Identification of Faraday's law as embodied by Maxwell's Equations • Line and surface integrals • Green's theorem, Stoke's theorem and Divergence theorem • Application	
27.3.4	Matrices II	• Definition of Eigen values and Eigen vectors • Calculation of Eigen values and Eigen vectors • Definition • Explanation of function of matrices • Definition of Jordan form of a matrix • Definition of transition matrix	12
27.3.5	Numerical methods	• Application of iterative methods to solve equations • Applications of interpolation and extrapolation • Definition of interpolations and extrapolations	12
27.3.6	Complex variables	• Functions of complex variables • Derivatives of analytic functions • Cauchy- Riemann equation	10
Total Time			**88**

27.3.1 FOURIER SERIES

Theory

27.3.1T0 *Specific Objectives*

By the end of the sub - module unit, the trainee should able to:

a) define the Fourier series of a function
b) determine the Fourier series for a periodic function of period 2π and expanded to period T.
c) determine the Fourier series for a non-periodic function for the range 2π and extended to T.
d) determine the Fourier series for odd and even function
e) find the numerical harmonics

Content

27.3.1T1 Definition of Fourier series for a function

27.3.1T2 Determination of the Fourier series for periodic function of period 2π and extended to T.

i) Mathematical definition
ii) Graphical illustration
iii) Periodic properties of cosine and sine functions

27.3.1T3 Determination of Fourier series of a non periodic functions

i) Explain that a non-periodic function cannot, in general, be expanded in
ii) Fourier series
iii) Description of how a function can be expanded.
iv) Graphical illustration of the function

27.3.1T4 Determination of the Fourier series for non-periodic functions over a given range x2, $0<x<5$

27.3.1T5 Determination of Fourier series for odd and even functions and the half-range series

i) Definition of odd and even functions
ii) Calculation of numerical harmonics and its application.

27.3.2 MULTIPLE INTEGRALS

Theory

27.3.2T1 *Specific Objectives*

By the end of the sub - module unit the trainee should be able to:

a) define multiple integrals
b) use double integrals to find areas and volumes
c) apply double integrals in polar and cylindrical coordinates
d) use of triple integrals in solving problems

Content

27.3.2T1 Definition of Double integrals and Triple integrals

27.3.2T2 Using double integrals to find areas and volumes.

27.3.2T3 Apply double and triple integrals in polar, cylindrical and spherical coordinates

27.3.2T4 Use of triple integrals in solving problems

27.3.3 VECTOR FIELD II

THEORY

27.3.3 *Specific Objectives*

By the end of the sub-module, the trainee should be able to:

a) proof Green's theorem
b) apply Green's theorem to line integrals
c) state two distinct but closely related physical interpretations of Green's theorem.
d) extend Green's theorem to Stoke's theorem.
e) apply Stoke's theorem.
f) apply Gauss's theorem.
g) define conservative vector fields
h) apply conservative vector fields.
i) use surface integral
j) apply surface integral
k) state Maxwell's equations in the modern analysis using divergence and curl.
l) identify Faraday laws as embodies by Maxwell's equations.
m) classify solutions of Maxwell's equations.
n) define pointing theorem

Content

27.3.3T1 Green's theorem
i) Statement
ii) Proof

27.3.3T2 Application of Green's theorem to line integrals

27.3.3T3 Statement of two distinct but closely related physical interpretation of Green's theorem
i) Unit tangent vector
ii) Unit normal vector

27.3.3T4 Extension of Green's theorem to Stoke's theorem

27.3.3T5 Application of Stoke's theorem

27.3.3T6 Application of Guss's Theorem

27.3.3T7 Extension of Green's theorem to Gauss's theorem;

27.3.3T8 Application of Gauss's theorem

27.3.3T9 Definition of conservative vector fields

27.3.3T10 Application of conservative vector fields
iii) Potential energy
iv) Kinetic energy
v) Work

27.3.3T11 Use of surface integrals

27.3.3T12 Application of surface integrals
i) Flux
ii) Area

27.3.3T13 Statement of Maxwell's equation in the modern analysis using divergence and curl.

i) $\frac{e^{3}}{2 +}$

27.3.3T14 Identification of Faraday's law as embodied by Maxwell's Equations

27.3.3T15 Definition of Pointing Theorem
- i) Application of Pointing Theorem

27.3.4 MATRICES II

27.3.4T0 *Specific Objectives*

By the end of the sub-module unit the trainee should able to:
- a) define Eigen values and Eigenvectors of a matrix
- b) calculate Eigen values and Eigenvectors of a matrix
- c) define the Jordan form of a matrix
- d) explain the meaning of function of a matrix
- e) define transform action matrix
- f) define transition matrix

Content

27.3.4T1 Definition of Eigen values and Eigen vectors
- i) Eigen values
- ii) Eigenvectors
- iii) Characteristic polynomials
- iv) Distinct Eigen values
- v) Normalized Eigen vectors

27.3.4T2 Calculation of Eigen values and Eigen vectors

27.3.4T3 Definition of Jordan form of a matrix

27.3.4T4 Explanation of function of matrices

27.3.4T5 Definition
- i) Similarity transformation
- ii) Properties of similarity transformation
- iii) Exponential and meaning
- iv) Logarithms of matrices

27.3.4T6 Definition of transition matrix
- v) Properties of continuous time transition matrix for a linear time varying system.

27.3.5 NUMERICAL METHODS

Theory

27.3.5T0 *Specific Objectives*

By the end of the sub-module unit, the trainee should able to:
- a) define interpolation and extrapolation
- b) apply interpolation and extrapolation
- c) apply iterative methods to solve equations

Content

27.3.5T1 Definition of interpolations and extrapolations

27.3.5T2 Applications of interpolation and extrapolation

27.3.5T3 Application of iterative methods to solve equations

i) Newton-Raphson method
ii) Newton-Gregory method

27.3.6 COMPLEX VARIABLES

Theory

27.3.6T0 *Specific Objectives*

By the end of the sub - module unit, t the trainee should be able to:

a) define a function of a complex variable
b) differentiate a function of a complex variable
c) define Analytic (regular) functions
d) derive Cauchy-Riemann equations

Content

27.3.6T1 Definition of function of a complex variable

27.3.6T2 Differentiation of a complex function

27.3.6T3 Definition of Analytic (regular) functions

27.3.6T4 Definition of Cauchy-Riemann equations

Suggested Teaching/Learning Activities

- Discussion
- Illustration
- Demonstration
- Note taking

Suggested teaching/Learning Resources

- Advanced Mathematical tables
- Scientific calculator

Suggested Evaluation Methods

- Oral tests
- Timed written tests
- Assignments