APPLIED MATHEMATICS FOR CRAFT ENGINEERING
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FOR
CRAFT ENGINEERING
BY
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JOMO KENYATTA FOUNDATION
Applied Mathematics for Craft Engineering is designed for the Craft Engineering Syllabus as set out by the Kenya Institute of Education (KIE). The book emphasizes a practical and student-centred approach to learning Applied Mathematics. Prior to publication of the book, the manuscript was tested at Thika Technical Training Institute, where it was found to be useful and relevant to craft, technician and diploma courses.

The book covers topics intended to provide students with skills and techniques necessary for solving Engineering course problems.

This fine piece of work is the result of commendable research by experienced authors with a solid background in Applied Mathematics.

I recommend the text as a set book for use in Technical Institutes, and National Polytechnics. Other educational institutions including secondary schools will find it useful as a reference book.

H. MAGARE

Principal - Thika Technical Training Institute - Thika, Kenya
PREFACE

*Applied Mathematics for Craft Engineering* book follows closely the syllabus drawn by the Kenya Institute of Education (KIE) for the new craft training programme.

This book will assist students in following the mathematics programme as laid down in their various fields of study. The textual material is interspersed with an abundance of illustrative examples and comprehensive exercises for further practice. The topics in this book are set out to provide learners/trainees with mathematical skills and techniques that they may require wholly or partially in application to their different craft trades.

After successful completion of this course, the trainees/learners should be able to:

(a) Use mathematical concepts and techniques in solving problems related to their respective trade.

(b) Draw simple deductions and conclusion from given data.

(c) Interpret graphical representation of functions relevant to their respective trade.

The book assumes that the students have satisfactorily completed K.C.S.E. Mathematics Syllabus. Included is Chapter 12 on Differential and Integral Calculus for further reading.

At the end of the book there are several examination standard questions. We hope the reader will find the book suitable for the course. The book can also be used as a reference book by students pursuing technician courses.

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# CONTENTS

## FOREWORD

## PREFACE

### CHAPTER 1: Indices and Logarithms
- Conversion of numbers from one base to another
- Decimal, duodecimal and binary
- Laws of indices
- Application of laws of indices and logarithms
- Logarithmic equations and their solutions. Factorials.

### CHAPTER 2: Series
- Definition of a sequence
- Definition of series
- Definition of progression
- Specific examples on sequences and series
- Solutions of APs and GPs, simple and compound interest.

### CHAPTER 3: Ratios & Proportions
- Definition of rational and irrational numbers
- Expressing ratios as percentage and vice-versa
- Dependent and independent variables
- Proportions, direct and inverse proportions including solving specific examples.

### CHAPTER 4: Algebra
- Algebraic expressions
- Transposition of formulae using various examples
- Types of simultaneous equations including various methods of solving specific examples
- Quadratic equations and solving specific examples.

### CHAPTER 5: Graphs
- Plotting points on a cartesian plane
- Defining a linear law
- Plotting linear graphs
- Plotting parabolic curves of second degree $y = ax^2 + bx + c$
- Solving simultaneous and quadratic equations using graphs
- Defining charts and using charts to present data.

### CHAPTER 6: Mensuration
- Calculation of perimeters of rectangles, squares, triangle and circle.
- Calculation of areas of regular and irregular figures.
- Calculation of surface areas of irregular figures.
- Calculation of volumes of regular solids.

### CHAPTER 7: Matrices
- Definitions of matrix
- Order of matrices
- Operation of matrices
- Addition and subtraction, multiplication, transpose of a matrix
- Calculation of determinant and inverse
- Application of matrices to solve simultaneous equations.
CHAPTER 8: Probability and Statistics

- Definition of probability
- Definition of dependent, independent, mutually exclusive events as used in probability
- Definition of the laws of probability and their application in solving problems
- Definition of the term statistics
- Differentiating between grouped and ungrouped data
- Data collection, tabulation of data, data representation, interpretation of data
- Binomial theorem, binomial distribution, normal distribution and Poisson distribution.

CHAPTER 9: Commercial Calculations

- Conversion of one currency to another
- Kenyan currency to foreign currency, foreign currency to Kenyan currency, foreign currency to foreign currency
- Calculation of exchange rates
- Calculation of the selling prices and buying price of items
- Calculation of loss and profit given the selling and buying price
- Calculation of income tax given insurance, single and married relief and any other benefits
- Calculation of average sales.

CHAPTER 10: Trigonometry

- Conversion of degrees to radians
- Trigonometric ratios and their reciprocals
- Use of Pythagoras theorem to prove simple trigonometric identities
- Solving simple trigonometric equations of the form \( a + b \sin x = c \) or \( a \sin^2 x + b \cos x = c \)
- Double angles, determination of trigonometric ratios of angles greater than 90°
- Solutions of triangles using sine and cosine rules
- Construction of sine and cosine waves.

CHAPTER 11: Vectors

- Definition of vectors
- Manipulation of vectors, addition, subtraction, magnitude
- Direction, resolutions of vectors, vertical and horizontal components of vectors
- Triangles of forces and parallelogram of forces.

CHAPTER 12: Differential and Integral Calculus

- Rate of change,
- Gradient of a curve
- Differentiation from first principles
- Derivative of \( x^n \), \( ax^n \), constant, \( x^{m/n} \)
- Differentiation of general formulae, maximum and minimum values,
- Derivatives of \( \sin x \) and \( \cos x \),
- Integration, integral notation, definite integrals, area under a curve.

REVISION EXERCISES

ANSWERS: Chapter 1 - 12

ANSWERS: Revision Exercises
APPLIED MATHEMATICS FOR CRAFT ENGINEERING

Mathematics is a service subject for engineers, technicians and all those undertaking courses in craft related subjects. They therefore require well tailored Mathematics to assist them in solving technological problems in their respective trades. *Applied Mathematics for Craft Engineering* aims at filling the gap that exists in the market in this area. Based on the syllabus for technician courses in the Technical Institutes, Institutes of Technology and Polytechnics, the book presents problems, worked examples and test paper questions that would enable trainees comfortably pass their Technician exams without much difficulty.

**Prof. S. M. Uppal**, a Phd. holder in Mathematics, has much experience in teaching University Mathematics at university level and is the current Chairman of the Mathematics and Computer Science Department at Jomo Kenyatta University of Agriculture and Technology.

**S. N. Gicharu**, a graduate teacher of Mathematics, has extensive experience of teaching Mathematics in various secondary schools in Kenya. Currently Gicharu is a Mathematics lecturer at Thika Technical Institute and a part time lecturer in Mathematics at Jomo Kenyatta University of Agriculture and Technology.

**J. A. N. Kamau** has broad experience of teaching Applied Mathematics to technicians. Currently Kamau is the Head of the Mathematics Department at Thika Technical Institute.

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