Dr Norazaliza binti Mohd Jamil is currently a Senior Lecturer at the Faculty of Industrial Sciences & Technology in Universiti Malaysia Pahang (UMP). She received her Bachelor of Science (Mathematics) with First Class Honours and Master of Science (Mathematics) from Universiti Teknologi Malaysia (UTM). She completed her Doctor of Philosophy (PhD) in Applied and Computational Mathematics at the University of South Carolina, USA in 2015.

Dr Nor Alisa binti Mohd Damanhuri is a Senior Lecturer at the Faculty of Industrial Sciences in Universiti Malaysia Pahang (UMP). She obtained her BSc. (Mathematics) and MSc. (Applied Mathematics) from Universiti Sains Malaysia (USM). She subsequently received her Ph.D in Mathematics from the University of Manchester, UK in 2014.

Dr. Yuhani binti Yusof currently serves as a Senior Lecturer at the Faculty of Industrial Sciences & Technology in Universiti Malaysia Pahang (UMP). She graduated from Universiti Teknologi Malaysia (UTM), with BSc. (Industrial Mathematics) and MSc. (Mathematics). She completed her PhD at the same university in 2012 and attached as a visiting scholar at Towson University, USA under SLAI scholarship. Having experienced 12 years in teaching of various subjects: Engineering Mathematics, Computer Programming, MATLAB, Discrete Structure & Applications, Basic Mathematics and Calculus, she also actively involves in research related to biomathematics field i.e. journal editor, scientific reviewer, research grant, indexed publication and copyright. She was awarded the Certificate of Excellence in Teaching for every semester and has received one gold, one silver and four bronze medals through her research. Besides, she actively involves in academic administration and community services.

Nor Aida Zuraimi binti Md Noar is currently a Senior Lecturer at the Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang (UMP). She received her Bachelor of Science (Industrial Mathematics) from Universiti Teknologi Malaysia (UTM). Upon completion of her bachelor's degree, she was appointed as a Tutor at Universiti Pendidikan Sultan Idris (UPSI) in 2002 before she continued her postgraduate study in Master of Science (MSc) in Computational Mathematics with Modelling at Brunel University, UK. She was then appointed as a lecturer at UPSI. Having completed her Doctor of Philosophy (PhD) in Applied Mathematics at Brunel University, UK in 2012, she was promoted as a senior lecturer at UPSI before joining UMP in 2013.

Norhafizah binti Md Sarif received her Bachelor of Science (Industrial Mathematics) from Universiti Teknologi Malaysia (UTM) in 2004. Upon completion of her degree program, she pursued her postgraduate study in Master of Science (Applied Mathematics) at the same university and completed her Master degree in 2005. In 2006, she was appointed as a Mathematics Lecturer at Universiti Malaysia Pahang (UMP). She has been serving UMP for more than 10 years and given assignments to teach Basic Mathematics, Calculus, Ordinary Differential Equations, Engineering Mathematics and Numerical Methods. She is currently pursuing her doctoral studies in Applied Mathematics at UMP.



PUBLISHER UNIVERSITI MALAYSIA PAHANG



For Internal Circulation Only

Mathematical Formulae

Norazaliza Mohd Jamil Nor Alisa Mohd Damanhuri Yuhani Yusof Nor Aida Zuraimi Md Noar Norhafizah Md Sarif

Mathematical Formulae

Mathematical Formulae

Norazaliza Mohd Jamil Nor Alisa Mohd Damanhuri Yuhani Yusof Nor Aida Zuraimi Md Noar Norhafizah Md Sarif

> Publisher Universiti Malaysia Pahang Kuantan 2017

Copyright © Universiti Malaysia Pahang, 2017

First Published, 2017 Second Published, 2017

All right reserved.

Apart from fair dealing for the purpose of study, research, criticism or review, as permitted under the Copyright Act, no part of this book may be reproduced, strored in a retrieval system, or transmited, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the publisher. Enquiries to be made to the author and the publisher Penerbit Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang Darul Makmur. Negotiation is subject to royalty arrangement or honorarium.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

Norazaliza Mohd. Jamil

Mathematical Formulae / Norazaliza binti Mohd Jamil, Nor Alisa binti Damanhuri. Yuhani binti Yusof, Nor Aida Zuraimi binti Md Noar, Norhafizah binti Md Sarif. ISBN 978-967-2054-16-0 1. Mathematics--Formulae. I. Nor Alisa Damanhuri. II. Yuhani Yusof.

III. Nor Aida Zuraimi Md. Noar. IV. Norhafizah Md. Sarif. V. Title. 510.212

Published By: Publisher

Universiti Malaysia Pahang, Lebuhraya Tun Razak, Pahang Darul Makmur. Tel: 09-549 3320 Fax: 09-549 3381

Printing:

Warisan Printing (CA 0122761-M) G4, Block B Medan Warisan, Lorong Seri Teruntum 1, 25150 Kuantan, Pahang Darul Makmur Tel: 013-920 8271 Email: warisanprinting2017@gmail.com

Preface

Mathematical Formulae intends to provide students, scientists, engineers, and researchers with a readily available reference to the mathematical formulae needed during their studies or work situation. It is a handy book that one must have on the bookshelf. The text is divided, for ease of reference, into ten main chapters embracing algebra, trigonometry, limit, differentiation and integration, vector calculus, coordinate geometry, differential equations, numerical methods, discrete mathematics, and financial mathematics. Essential theory, formulae, definitions and laws are clearly stated in this book. This collection of formulas constitutes a compilation of mathematics for Engineering and Sciences. In addition, people who often deal with practical or applied problems will also find this collection an efficient and easyto-use work of reference. The present book arose as a result of many years of teaching experience of various faculties in Universiti Malaysia Pahang (UMP) which are Chemical & Natural Resources Engineering, Civil Engineering & Earth Resources, Computer Systems & Software Engineering, Electrical & Electronics Engineering, Industrial Sciences & Technology, Manufacturing Engineering, Mechanical Engineering, Engineering Technology and Industrial Management. The text assumes little previous knowledge and is suitable for a wide range of courses in UMP. Finally, we would also like to emphasize that remarks and criticism are always welcome.

Contents

1	Algebra	7
1.1	Indices Rules	7
1.2	Logarithm and Exponent Rules	7
1.3	Surds	8
1.4	Absolute Values	8
1.5	Factoring Rules	8
1.6	Quadratic Formula	8
1.7	Complex Number	9
1.8	Matrix	9
1.9	Arithmetic Series	10
1.10	Geometric Series	10
1.11	Binomial Series	10
1.12	Taylor Series	10
1.13	Maclaurin Series	10
1.14	Partial Fractions	11
2	Trigonometry	13
2.1	Trigonometric Ratios	13
2.2	Special Angles	14
2.3	Basic Identities	15
2.4	Angle Sum and Difference Identities	16
2.5	Double-Angle Identities	16
2.6	Half-Angle Identities	16
2.7	Sum Identities	17
2.8	Hyperbolic Identities	17

3	Limit	. 19
3.1	Basic Properties of Limits	19
3.2	Properties of Limits	19
3.3	Limits of Logarithm Functions	20
3.4	Continuity	20
4	Differentiation and Integration	. 21
4.1	Basic Properties of Differentiation	21
4.2	Derivatives of Basic Functions	21
4.3	Higher Order Derivatives	21
4.4	Basic Properties of Definite Integrals	22
4.5	Integrals of Basic Functions	23
4.6	Basic Differentiation and Integration	23
4.7	Trigonometric Functions	24
4.8	Hyperbolic Functions	24
4.9	Inverse Trigonometric Functions	25
4.10	Applications of Integration	27
5	Vector Calculus	. 31
5.1	Polar Coordinates	31
5.2	Vectors and Geometry of Space	31
5.3	The Dot Products and Cross Product	31
5.4	Equation of Planes	32
5.5	Vector Functions	32
5.6	Vector Calculus	33
5.7	Multiple Integrals	34
6	Coordinate Geometry	. 37
6.1	Straight Line	37
6.2	Exponential and Logarithmic Graph	37
6.3	Quadratic Graph	37
6.4	Cubic Graph	38
6.5	Rational Graph	38

Circle and Ellipse	39
Graphing Techniques	39
Polar Coordinate	40
Cylindrical Coordinate	41
Spherical Coordinate	41
Three-Dimensional Graphs	41
Area	43
Surface Area and Volume	44
Differential Equations	47
Jargon	47
First Order Ordinary Differential Equations	47
Second Order Homogeneous Differential Equations	48
Second Order Non-Homogeneous Differential Equation 49	ons
Mean Value	50
Table of Laplace Transforms	50
Properties of Laplace Transforms	52
Laplace Transforms of Derivatives	52
Fourier Series	53
Numerical Methods	55
Errors	55
Roots of Equations	55
Linear Algebraic Equations and Matrices	56
Curve Fitting	57
Numerical Integration	58
Ordinary Differential Equations: Initial Value Problem	58
Ordinary Differential Equations: Boundary Value Proble 60	əm
Discrete Mathematics	61
Set Theory	61
	Graphing Techniques Polar Coordinate Cylindrical Coordinate Spherical Coordinate Three-Dimensional Graphs Area Surface Area and Volume Differential Equations Jargon First Order Ordinary Differential Equations Second Order Homogeneous Differential Equations Second Order Non-Homogeneous Differential Equations Second Order I aplace Transforms Laplace Transforms of Derivatives Fourier Series Numerical Methods Errors Roots of Equations Linear Algebraic Equations and Matrices Curve Fitting Numerical Integration Ordinary Differential Equations: Initial Value Problem Ordinary Differential Equations: Boundary Value Problem Ordinary Differential Equations: Boundary Value Problem Ordinary Differential Equations: Boundary Value Problem

9.2	Boolean Identities	62
9.3	Basic Counting	63
9.4	Elementary Number Theory	63
9.5	Discrete Probability	64
9.6	Discrete Distribution	65
9.7	Mathematical Expectation	66
9.8	Euler's Formula	66
9.9	Tree	67
9.10	Numerical Precision, Accuracy and Errors	67
10	Financial Mathematics	69