



College of Engineering, Science and Technology
School of Electrical and Electronics Engineering
Advanced Diploma in Engineering (Electrical & Electronics)

EEE605 Mathematics for Engineers

Final Exam Question Paper

Semester 1, 2016

Time Allocated: **3 hours**
(with extra 10 minutes for Reading Time)
Total Marks: 100

Instructions

1. This paper has 3 sections and is 4 pages long, excluding this cover page. The marks allocation is given below.

Section A 30 marks

Section B 35 marks

Section C 35 marks

2. Answer all questions in the Answer Booklet provided and show all workings where necessary. This exam contributes 50% to your overall mark.
3. Begin each section on a fresh page and use both sides of the sheet.
4. Write your candidate I.D. Number at the top of each attached sheet.
5. Non-programmable calculators may be used.

Section A Linear Algebra (30 marks)

1. Solve the system using Gauss-Jordan elimination.

[Hint: Reduce the augmented matrix to reduced row-echelon form]

$$\begin{aligned}x_1 - 3x_3 &= -2 \\3x_1 + x_2 - 2x_3 &= 5 \\2x_1 + 2x_2 + x_3 &= 4\end{aligned}$$

(5 marks)

2.

- (a) State the definition of a basis S and dimension of a vector space V .
- (b) Write down the standard basis for the vector space \mathbb{R}^3 with standard operations.
- (c) Determine whether the set S given is a basis for \mathbb{R}^3 .

$$S\{(1, 2, 3), (0, 1, 2), (-2, 0, 1)\}$$

(5 marks)

3. Find a basis for, and the dimension of, the solution space $Ax = \mathbf{0}$.

[Hint: Find the basis for nullspace]

$$A = \begin{bmatrix} 1 & 2 & -3 \\ 2 & -1 & 4 \\ 4 & 3 & -2 \end{bmatrix}$$

(5 marks)

-
4. Find the least squares regression line for the set of data given below.
[Hint: Find the equation of best-fit line $y = ax + b$ modeling this data]

$$\{(1, 0), (3, 3), (5, 6)\}$$

(5 marks)

5. Solve the system of first-order linear differential equations.

$$\begin{aligned}y_1' &= y_1 + 2y_2 \\y_2' &= 2y_1 + y_2\end{aligned}$$

(10 marks)

Section B Vector Calculus (35 marks)

1. Given $w = e^y \cos x$, find $w_{xyy} \left(\frac{\pi}{4}, 0 \right)$. [Hint: Use radians]

(5 marks)

2. Let $f(x, y) = x^2 - 3xy + 4y^3$.

(a) Find $\nabla f(x, y)$.

(b) Find $D_u f$ at the point $(-2, 0)$ in the direction of $\mathbf{u} = \mathbf{i} + 2\mathbf{j}$.

(5 marks)

3. Find the volume of the solid under the surface $z = xy$ and above the triangle with vertices $(1, 1)$, $(4, 1)$ and $(1, 2)$.

(7 marks)

4. Evaluate the line integral $\int_C \mathbf{F} \cdot d\mathbf{r}$, where

$$\mathbf{F}(x, y, z) = x\mathbf{i} - z\mathbf{j} + y\mathbf{k}$$

and C is given by the vector function

$$\mathbf{r}(t) = 2t\mathbf{i} + 3t\mathbf{j} - t^2\mathbf{k}, \quad -1 \leq t \leq 1.$$

(8 marks)

5. Use Green's Theorem to evaluate the line integral

$$\oint_C xy^2 dx + 2x^2 y dy,$$

where C is the positively oriented triangle with vertices $(0, 0)$, $(2, 2)$ and $(2, 4)$.

(10 marks)

Section C Differential Equations (35 marks)

1. Solve the given first order ODEs.

(a) $y' + 2y = 2e^x$.

(b) $y' = y^2 \sin x$.

(8 + 7 marks)

2. Given a simple electric circuit with resistance 12Ω , inductance $4H$, and a battery supplying constantly 60 volts. If the switch is closed at $t = 0$, we can model the circuit as $L\frac{dI}{dt} + RI = E$. With the initial condition of $I(0) = 0$, estimate the current in the circuit half a second after the switch is closed. Use Euler's method with step size of 0.1.

(10 marks)

3. Find the general solution $y = y_h + y_p$ for the ODE below, where y_p is to be found using **Method of Variation of Parameters**.

$$y'' + 9y = \sec 3x$$

(Hint: MVP: $y_p = -y_1 \int \frac{y_2 x}{W} dx + y_2 \int \frac{y_1 x}{W} dx$)

(10 marks)

The End
(All the best for the paper)

EQP RECEIPT CHECKLIST FORM

Particulars	Details/Comments (To be filled by Unit Lecturer)	Tick if present on EQP (To be filled by exams staff)
Cover Page		
Fiji National University with Logo	✓	
College	✓	
School	✓	
Program	✓	
Unit Code	✓	
Unit Name	✓	
Examination Period	✓	
Duration of Examination	✓	
Instructions	✓	
Total Number of Pages	✓	
Other Pages		
Footer		
Page Number	✓	
Unit Code	✓	
Examination Period	✓	
Last Page		
The End	✓	
Overall		
Proper Print	✓	
Examination Requirements (FNU/E-1)	✓	
Moderator's Report (FNU/E-3)	✓	
ERRS (Class List)	✓	
Unit Coordinator/Principal Lecturer's Name	Alveen Chand	

DISPATCHED BY (SCHOOL REP)

 NAME: Alveen Chand

 SIGN: [Signature]

 DATE: 17/05/16

RECEIVED BY (EXAMS REP)

NAME: _____

SIGN: _____

DATE: _____