



College of Engineering, Science and Technology

School of Mathematical & Computing Sciences

EEE605 Mathematics for Engineers

Semester I

FINAL EXAMINATION

2017

Programme: Advanced Diploma in Engineering (Electrical and Electronics)

Time Allowed: 3 Hours 10 Minutes

100 Marks

Time:

Date:

Instructions:

1. There are a total of 4 pages in the paper.
2. There are 10 questions. All questions are **COMPULSORY**.
3. You are allowed 10 minutes extra reading time during which you are **NOT** allowed to write.
4. Answer each question neatly on a new page in the answer booklet provided and clearly number the question attempted. All relevant working must be shown.
5. Students may use a calculator, provided it is silent & non-programmable.
6. If you use extra sheets of paper, attach it securely to the answer booklet.
7. Write your student identity number at the top of each sheet used.

Question 1:**[10 Marks]**

- a) Use Euler's method with step size 0.2 to estimate $y(1)$, where $y(x)$ is the solution of the initial value problem $y' = xy - x^2$. [5 Marks]
- b) Find the orthogonal trajectories of the family of curves $x^2 + 2y^2 = c$. [5 Marks]

Question 2:**[10 Marks]**

Solve the following differential equations:

- a) $\frac{dy}{dx} + \frac{y}{x} = 2$ [5 Marks]
- b) $x^2 y'' - 6y = 0$ [5 Marks]

Question 3:**[10 Marks]**Find the general solution of the nonhomogeneous equation $y'' + 2y' + 2y = x^2 - 2\sin 3x$.**Question 4:****[10 Marks]**Solve $y'' + 9y = \sec 3x$ by variation of parameters method.**Question 5:****[10 Marks]**

- a) Find $\frac{\partial^2 f}{\partial x^2}$ and $\frac{\partial^2 f}{\partial x \partial y}$ if $f(x, y) = 9 - x^2 - 7y^3$. [5 Marks]
- b) Find the directional derivative of the function $f(x, y) = e^{2xy}$ at the point $(4, 0)$ in the direction of the unit vector $\mathbf{u} = -\frac{3}{5}\mathbf{i} + \frac{4}{5}\mathbf{j}$. [5 Marks]

Question 6:**[10 Marks]**

a) Evaluate the line integral $\int_C (x + y) ds$ over the line $\mathbf{r}(t) = t\mathbf{i} + 2t\mathbf{j}$ where $0 \leq t \leq 1$.

[5 Marks]

b) Use Green's theorem to evaluate the line integral

$\oint_C (3x + 6xy - y^3) dx + (4y + 3x^2 - 3xy^2) dy$ where C is the unit circle oriented counterclockwise.

[5 Marks]

Question 7:**[10 Marks]**

If $\mathbf{F}(x, y, z) = xz^3 \mathbf{i} + 2y^4x^2 \mathbf{j} + 5z^2y \mathbf{k}$ then find:

a) $\text{div } \mathbf{F}$

[5 Marks]

b) $\text{curl } \mathbf{F}$

[5 Marks]

Question 8:**[10 Marks]**

(a) Determine whether the set of all 2×2 singular matrices with the standard operations is a vector space. If it is not, identify at least one vector axiom that fails.

[5 Marks]

(b) Determine whether the set S is linearly independent or linearly dependent.

$$S = \{(-2, 4), (1, -2)\}$$

[5 Marks]

Question 9:**[10 Marks]**

If A is a 4×5 matrix as given below

$$A = \begin{bmatrix} 1 & 2 & 1 & 0 & 0 \\ 2 & 5 & 1 & 1 & 0 \\ 3 & 7 & 2 & 2 & -2 \\ 4 & 9 & 3 & -1 & 4 \end{bmatrix}$$

Then find:

(a) rank and nullity of A .

(b) basis for the column space of A .

Question 10:

[10 Marks]

Solve the system of linear differential equations.

$$y_1' = 3y_1 + 2y_2$$

$$y_2' = 6y_1 - y_2$$

THE END