# BINDURA UNIVERSITY OF SCIENCE EDUCATION

## BACHELOR OF SCIENCE IN ELECTRONIC ENGINEERING



## EEE2201: ENGINEERING MATHEMATICS

Time: 3 hours

Candidates may attempt **ALL** questions in Section A and **TWO** questions in Section B. Each question should start on a fresh page.

### SECTION A (40 marks)

Candidates may attempt ALL questions being careful to number them 1 to 5.

1. Use the standard expansions of functions to find the value of the following limit.

$$\lim_{x\to 0}\left[\frac{\cos 7x - 1}{x\sin x}\right]$$

5

2.

$$z = 5xy - 6x^2 - y^2 + 7x - 2y$$

Investigate the critical points of $z$. 5

3. Find the solution for the following differential equations

   (a) $(9x^2+4)\frac{dy}{dx} + 9xy = 1$ 5

   (b) $x\frac{dy}{dx} + 5y = \frac{\ln x}{x}$ 5

   (c) $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 6y = 12(x + e^x)$ 6

4. The complex number $z$ satisfies the equation

$$4z + 3\overline{z} = \frac{1 - 18i}{2 - i}$$

where $\overline{z}$ denotes the complex conjugate of $z$. Solve the equation, giving the answer in the form $x + iy$, where $x$ and $y$ are real numbers. 10

5. Explain the significance of the gradient in the context of engineering. 4

## SECTION B (60 marks)

Answer any **TWO** questions

6. Consider the following hyperbolic equation, given in terms of k

$$2\cosh^2 x = 3\sinh x + k$$

(a) Find the range of values of k for which the above equation has no real solutions. 10

(b) Given further that $k = 1$, find the exact logarithmic form the solutions of the above equation. 10

(c) Explain divergence and its significance in the context of vector fields. 10

7. (a) State Green's theorem and explain its significance in engineering applications. 12

(b) Find the exact value of

$$\int_0^{\frac{\pi}{2}} \int_0^{4\cos z} \int_0^{\sqrt{16-y^2}} 3y \, dx \, dy \, dz$$

10

(c) A curve is given parametrically by the equations
$x = 2\sinh t$ ,$y = \cosh^2 t$ ,$t \in \mathbb{R}$
Find a Cartesian equation of the curve, in the form $y = f(x)$ 8

8. (a)

$$\mathbf{F} \equiv i + 2z\mathbf{j} + y\mathbf{k}$$

Evaluate the vector integral

$$\int_V \mathbf{F} dV$$

where $\mathbf{V}$ is the finite region enclosed by the cylinder with

$$x^2 + y^2 = 9, 0 \leq z \leq 2$$

15

(b) Evaluate the integral

$$\int_s (xy + z) dS$$

where **S** is the plane with Cartesian equation

$$2x - y + z = 3$$

whose projection onto the plane with equation $z = 0$ is the rectilinear triangle with vertices at $(0, 0)$, $(1, 0)$ and $(1, 1)$. 15