

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mathematics and Philosophy of Engineering



Study Programme : Bachelor of Honours in Software Engineering
Name of the Examination : Final Examination
Course Code and Title : MHZ3459 Basic Mathematics for Computing
Academic Year : 2024/25
Date : 14th February 2026
Time : 0930-1230h
Duration : 3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Five (5)** questions in **Three (3)** pages.
3. Answer **four** questions.
4. All questions carry equal marks.
5. Answer for each question should commence from a new page.
6. This is a Closed Book Test (CBT).
7. Non-Programmable Calculators are Allowed.

Question 01

- a). Find the area of the triangle with vertices $A(4, 3)$, $B(\lambda, 5)$, and $C(5, \lambda)$.

Hence, determine the value(s) of λ for which the points A , B , and C are collinear.

(30 Marks)

- b). Find the values of a and b such that $x^n = (x^2 - 2x + 1)\phi(x) + ax + b$, where n is a positive integer greater than 1, and $\phi(x)$ is a polynomial of x with degree $n - 2$.

(20 Marks)

- c). Let $A = \begin{bmatrix} 7 & 4 \\ -9 & -5 \end{bmatrix}$.

- α). Prove that $A^2 - 2A + I_2 = 0_2$. Hence, find a matrix B such that $B^2 = 0_2$ but $B \neq 0_2$, where I_2 and 0_2 are the unit matrix of order 2 and zero matrix of order 2 respectively.

(30 Marks)

- β). Using part b), prove that $A^n = \begin{bmatrix} 1 + 6n & 4n \\ -9n & 1 - 6n \end{bmatrix}$, where n is a positive integer greater than 1.

(20 Marks)

Question 02

- a). Evaluate the following limits:

$\alpha).$ $\lim_{x \rightarrow 5} \left(\frac{x-5}{\sqrt{x+31}-6} \right).$

$\beta).$ $\lim_{x \rightarrow 0} \left[\frac{\tan^2(45x)}{x^2} \right].$

(40 Marks)

b). Let $y = \tan^{-1} \left(\frac{e^{x^2} - 1}{e^{x^2} + 1} \right).$

$\alpha).$ Prove that $\frac{dy}{dx} = \frac{2xe^{x^2}}{e^{2x^2} + 1}$. Hint: $\frac{d}{dx} (\tan^{-1} x) = \frac{1}{1+x^2}.$

$\beta).$ Differentiate y with respect to e^{x^2} . (30 Marks)

- c). Using calculus, find the dimensions and maximum volume of a cylinder that can be inscribed in a sphere of given radius. (30 Marks)

Question 03

- a). A load balancer distributes incoming requests to a pool of servers. On day 1, it handles 1,200 requests. Each day, the number of requests increases by a fixed amount. On day 10, it handles 2,550 requests.

$\alpha).$ How many requests does it handle on day 15? (30 Marks)

$\beta).$ What is the total number of requests handled in the first 15 days?

- b). Using integration by parts, find $\int x \cos(ax) dx$, where $a \in \mathbb{R} - \{0\}$. (30 Marks)

- c). Using the substitution $t = \tan x$, evaluate the following definite integral.

$$\int_0^{\frac{\pi}{4}} \frac{1}{13 + 5 \cos 2x + 12 \sin 2x} dx.$$

Hint: $\cos 2x = \frac{1-t^2}{1+t^2}$ and $\sin 2x = \frac{2t}{1+t^2}.$ (40 Marks)

Question 04

- a). In an institute, there are two desktop computers, one old and one new, which function independently of each other. The probability that at least one of the computers is functioning properly is $\frac{5}{6}$, and the probability that both computers are functioning properly is $\frac{1}{3}$.

Find the probability that the old computer is functioning properly and the probability that the new computer is functioning properly. (40 Marks)

- b). A software module has a 3% chance of containing a defect.

An automated test detects a defect with 95% accuracy when a defect exists, but it falsely reports a defect 5% of the time when there is none.

If the test reports a defect, find the probability that the module actually has a defect.

(30 Marks)

- c). A team recorded daily fixed bugs over 5 days: {5, 7, 7, 2, 9}. Find the range, mode, mean, variance, and standard deviation.

(30 Marks)

Question 05

- a). The execution time (in milliseconds) of a software module for different input sizes is recorded as follows:

Input size (x)	100	200	300	400	500
Time (y)	18	25	36	51	70

Using Newton's Forward Difference Method, estimate the execution time when the input size is $x = 150$.

Explain why forward difference method is most suitable.

(50 Marks)

- b). Let $f(x) = x^3 - a^3$, where $x \in \mathbb{R}$ and $a \in \mathbb{R} - \{0\}$. Prove that $f(x) = 0$ has only one real root.

(20 Marks)

Using the Newton-Raphson method, find the real root of the equation

$x^3 - 5 = 0$ correct to nine decimal places taking initial approximation

$x_0 = 2$.

(30 Marks)

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