

THE OPEN UNIVERSITY OF SRI LANKA

Faculty of Engineering Technology

Department of Mathematics and Philosophy of Engineering



Bachelor of Software Engineering Honours Study Programme

Final Examination (2020/2021)

MHZ3459: Basic Mathematics for Computing

Date: 13th January 2022 (Thursday)

Time: 09:30 hrs. - 12:30 hrs.

Instructions:

- This paper consists of Eight (8) questions in Three (3) pages.
- Answer any Five (5) questions ONLY.
- State any assumptions you required.
- Show all your workings.

1. (a) Find the quotient and the remainder of $\frac{x^5 + 3x^4 + 2x^3 + x^2 + 3x + 4}{x^3 + 1}$. (marks 8)
- (b) Find the least common multiplicity of $x^3 + 1$ and $x^2 + 3x + 2$. (marks 4)
- (c) Find partial fractions of $\frac{x^5 + 3x^4 + 2x^3 + x^2 + 3x + 4}{x^3 + 1} + \frac{1}{x^2 + 3x + 2}$. (marks 8)
2. (a) Find the set of x such that $(4x^2 - 9)(x^2 + 4x + 4) \leq 0$, where $x \in \mathbb{R}$. (marks 4)
- (b) Let $A = \{a, b, c, f, g\}$, $B = \{b, c, f, h, i\}$, $C = \{b, d, e, f, g, i\}$. Draw a venn diagram to represent above details and write the elements of $A' \cap (B \cap C)$ and $B \cup (B \cup C)'$ in tabular form if $(A \cup B \cup C)' = \emptyset$. (marks 8)
- (c) In a particular hospital there are 58 number of male workers, and 15 number of doctors. 63 of them are either male or doctors. How many female doctors are there? (marks 8)

3. (a) Prove that $\frac{1}{\tan(5x) + \tan(x)} - \frac{1}{\cot(x) + \cot(5x)} = \cot(6x)$. (marks 8)

(b) Find all the possible values of x such that $\cot(x) + \cot(5x) = \tan(5x) + \tan(x)$. (marks 4)

(c) Because of shadows of surrounded trees, a coconut tree has grown so that it was leaning 8° from the vertical. At a point 38m from the opposite side of the tree where tree bends, the angle of elevation to the top of the tree is 25° . Assuming that the coconut tree is straight, find the height of the coconut tree. (marks 8)

4. (a) i. Prove that the derivative of $f(x) = \tan x$ is equal to $f'(x) = \sec^2 x$ using the definition of derivatives. (marks 8)

ii. Find the derivative of $g(x) = x \ln(2x) + e^{x^2} \tan x$. (marks 4)

(b) Find the maximum volume of a box with the height h , and side lengths $3 - h$, $4 - h$. All measurements are in meters. (marks 8)

5. (a) i. Find the integral $\int \frac{2x^5 + 6x^3 + 2x}{x^4 + 1} dx$. (marks 8)

ii. Evaluate the definite integral $\int_0^1 \frac{2x^5 + 6x^3 + 2x}{x^4 + 1} dx$. (marks 4)

(b) Find the integral $\int e^{3x} \sin x dx$ using integration by parts. (marks 8)

6. A machine is set to produce bearings with nominal length of 20mm. The lengths of a sample of 50 bearings give the following frequency distribution.

Length (mm)	Number of bearings
5 - 10	3
10 - 15	6
15 - 20	14
20 - 25	20
25 - 30	7

(a) Compute the mean, mode, and median lengths of the bearings. (marks 6)

- (b) Calculate Karl Pearsons coefficient of skewness from the given data and comment about the shape of the distribution.

(marks 8)

- (c) Construct a histogram and a frequency polygon for the above data.

(marks 6)

7. Following data values were read from a NPN transistor.

Base current (A): t	0	0.1	0.3	0.4
Collector current (A): I_c	0	1.2	5.4	9.6

- (a) Use the Lagrange's Interpolation and the data in table to find a polynomial which approximate the collector current when the base current is equal to t .

(marks 8)

- (b) What is the approximate collector current when the base current is equal to 0.2A.

(marks 4)

- (c) If the actual collector current is 3.32A when the base current is 0.2A, find a limiting relative error of collector current.

(marks 8)

8. (a) Let $A = \begin{pmatrix} 2 & 3 & 3 \\ 0 & -2 & 1 \\ -2 & 0 & 1 \end{pmatrix}$.

i. Prove that $A^3 - A^2 + 2A + 2I = 0$.

(marks 8)

ii. Find A^{-1} .

(marks 4)

- (b) Use matrices to find the area of the triangle whose vertices are $(2, 3)$, $(0, -2)$, $(-2, 0)$.

(marks 8)

End

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