



Differential and Integral Calculus 1

MS-A0111

Hakula

Ardiyansyah

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Please follow the instruction given on the exam page. Every question carries an equal weight, similarly every part of a question carries an equal weight, unless otherwise specified.

PROBLEM 1 Find the derivative of $f(x) = \cos x$ using Newton's Quotient with the help of the identity

$$\cos(\xi + k) = \cos(k) \cos(\xi) - \sin(k) \sin(\xi).$$

PROBLEM 2 (4p) Find the Maclaurin series of (Taylor series about the origin) of degree 3

$$f(x) = \sin(x + \pi/4).$$

(2p) Estimate the error at $x = \pi/4$. Report the true error $T_3(f)(\pi/4) - f(\pi/4)$ and the theoretical estimate and comment on the accuracy of the latter.

PROBLEM 3 Compute the integral

$$\int_0^4 \sin(\pi\sqrt{x}) dx,$$

using substitution $x = t^2$.

PROBLEM 4 Compute the integral

$$\int_0^{2\sqrt{\pi}} x \ln x dx.$$

PROBLEM 5 Solve the 2nd order ordinary differential equation

$$\begin{cases} y'' + 9y = \cos 2t, \\ y(0) = 1, \\ y'(0) = 0. \end{cases}$$