UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2008/2009

SUBJECT	:	MATHEMATICS I
CODE	:	BSM 1913
COURSE	:	1 BFF/ 1 BEE / 1 BDD/ 4 BER
DATE	:	APRIL 2009
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ALL QUESTIONS IN **PART A** AND **THREE (3)** QUESTIONS IN **PART B**

THIS EXAMINATION PAPER CONSISTS OF 6 PAGES

PART B

Q3 (a) Evaluate the following limits

(i) $\lim_{x \to 0} \frac{\sin 4x \sin 2x}{x \sin 3x}$

(ii) $\lim_{x \to 0} \frac{\sqrt{3+x} - \sqrt{3}}{x}$

(10 marks)

(b) Given

$$f(x) = \begin{cases} 9x - 2, & x \le 1 \\ kx^2, & x > 1. \end{cases}$$

Sketch the graph of $f(x)$ and find the value of constant k so that $f(x)$ is continuous at $x = 1$.

(7 marks)

(c) Find the value of x, where $\frac{x^2 - 9}{x^2 - 5x + 6}$ is discontinuous .

(3 marks)

Q4 (a) Determine the maximum and minimum points of

$$f(x) = 3x^2 - 18x + 15.$$

(10 marks)

(b) Find $\frac{dy}{dx}$, if

$$y = \frac{\sqrt[3]{x+1}}{(x+2)\sqrt{x+3}}.$$

(5 marks)

(c) The volume of a constant height cone is decreasing at a rate of 4 cm^3 s^{-1}. Find the rate of change in its cross sectional radius when the radius is 5cm and the height is 8cm.

(5 marks)

Q5 (a) Evaluate the following integrals by using the substitution method

(i) $\int 2x^3 \cos x^4 dx$

(ii) $\int 2\cos x e^{\sin x} dx.$

(12 marks)

(b) Solve $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{2dx}{\sin 2x}\, dx$.

(8 marks)

Q6 (a) Find the interval of convergence and radius of convergence of the power series

$$\sum_{k=0}^{\infty} \frac{(-1)^k x^k}{3^k (k+1)}.$$

(10 marks)

(b) Find the n[th] Taylor Polynomials for

$$f(x) = \frac{1}{(x-4)^2}$$

at $x_0 = 5$.

(10 marks)

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Formulae

Differentiation	Integration
$\frac{d}{dx}[\frac{x^{n+1}}{n+1}] = x^n, \quad n \neq -1$	$\int x^n dx = \frac{x^{n+1}}{n+1} + C, \quad n \neq 1$
$\frac{d}{dx}[e^x] = e^x$	$\int e^x = e^x + C$
$\frac{d}{dx}[\ln x] = \frac{1}{x}$	$\int \frac{dx}{x} = \ln\|x\| + C$
$\frac{d}{dx}[\sin x] = \cos x$	$\int \sin x dx = -\cos x + C$
$\frac{d}{dx}[\cos x] = -\sin x$	$\int \cos x dx = \sin x + C$
$\frac{d}{dx}[\tan x] = \sec^2 x$	$\int \sec^2 x dx = \tan x + C$
$\frac{d}{dx}[\cot x] = -\csc^2 x$	$\int \csc^2 x dx = -\cot x + C$
$\frac{d}{dx}[\sec x] = \sec x \tan x$	$\int \sec x \tan x dx = \sec x + C$
$\frac{d}{dx}[\csc x] = -\csc x \cot x$	$\int \csc x \cot x dx = -\csc x + C$
$\frac{d}{dx}[\cosh x] = \sinh x$	$\int \sinh x dx = \cosh x + C$
$\frac{d}{dx}[\sinh x] = \cosh x$	$\int \cosh x dx = \sinh x + C$
$\frac{d}{dx}[\tanh x] = \sec h^2 x$	$\int \sec h^2 x dx = \tanh x + C$

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Formulae

Differentiation	**Integration**
$\frac{d}{dx}[\coth x] = -\operatorname{csc}h^2 x$	$\int \operatorname{csc}h^2 x dx = -\coth x + C$
$\frac{d}{dx}[\operatorname{sec}hx] = -\operatorname{sec} x \tanh x$	$\int \operatorname{sec}hx \tanh x dx = -\operatorname{sec}hx + C$
$\frac{d}{dx}[\operatorname{csc}hx] = -\operatorname{csc}hx \coth x$	$\int \operatorname{csc}hx \coth x dx = -\operatorname{csc}hx + C$

Integration of Inverse Functions

$$\int \frac{dx}{\sqrt{a^2 - x^2}} = \sin^{-1}\left(\frac{x}{a}\right) + C$$

$$\int \frac{dx}{a^2 + x^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + C$$

$$\int \frac{dx}{|x|\sqrt{x^2 - a^2}} = \frac{1}{a}\sec^{-1}\left(\frac{x}{a}\right) + C$$

$$\int \frac{dx}{\sqrt{x^2 + a^2}} = \sinh^{-1}\left(\frac{x}{a}\right) + C, \quad a > 0$$

$$\int \frac{dx}{\sqrt{x^2 - a^2}} = \cosh^{-1}\left(\frac{x}{a}\right) + C, \quad x > a$$

$$\int \frac{dx}{x^2 - a^2} = \begin{cases} \frac{1}{a}\tanh^{-1}\left(\frac{x}{a}\right) + C & , |x| < a \\ \frac{1}{a}\coth^{-1}\left(\frac{x}{a}\right) + C & , |x| > a \end{cases}$$

$$\int \frac{dx}{x\sqrt{a^2 - x^2}} = -\frac{1}{a}\operatorname{sec}h^{-1}\left(\frac{x}{a}\right) + C, \quad 0 < x < a$$

$$\int \frac{dx}{x\sqrt{a^2 + x^2}} = -\frac{1}{a}\operatorname{csc}h^{-1}\left|\frac{x}{a}\right| + C, \quad 0 < x < a$$

Area of the region bounded above by $y = f(x)$, below by $y = g(x)$, on the left by the line $x = a$, on the right by the line $x = b$ is

$$A = \int_a^b [f(x) - g(x)]dx$$

Curvature: $$\kappa = \frac{\left|\frac{d^2y}{dx^2}\right|}{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2}}$$

Radius of curvature, $\rho = \frac{1}{\kappa}$

Surface Area of Revolution about x-axis is

$$S = 2\pi \int_a^b y\sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx$$

Parametric Curve

$$S = 2\pi \int_a^b y\sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt$$