CONFIDENTIAL

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	MATHEMATICS FOR ENGINEERING TECHNOLOGY I
COURSE CODE	:	BWM 12203
PROGRAMME	:	1 BNB / 1 BND / 1 BNL / 1 BNM / 1 BNN
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS.

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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Q1 (a) Find the Maclaurin polynomials p_0, p_1, p_2, p_3 and p_n for $f(x) = \cos x$.

(7 marks)

(b) Find the radius of convergence of $\sum_{n=0}^{\infty} 3(x-2)^n$.

(6 marks)

(c) Find the power series for $f(x) = \text{In } x$, centered at 1.

(7 marks)

Q2 (a) Find the following limits.

(i) $\lim_{x \to e^2} \frac{(\text{In } x)^2 - 4}{\text{In } x - 2}$.

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

(iii) $\lim_{x \to 0} \frac{\sin 2x}{\sin 3x}$.

(12 marks)

(b) Find constant A, so that the following function $f(x)$ will be continuous for all x.

$$f(x) = \begin{cases} \dfrac{x-1}{x+3}, & 0 \le x < 2; \\ \dfrac{1}{5}, & x = 2; \\ Ax^2 - 3, & x > 2. \end{cases}$$

(4 marks)

(c) By using L'Hôpital's rule, find $\lim_{x \to 2^+} \frac{\text{In}(x-1)}{(x-2)^2}$.

(4 marks)

Q3 (a) Differentiate $y = \cot(5x)\sec(7x)$ with respect to x.

(3 marks)

(b) Given $x = e^t$ and $y = \cos t$. Find

(i) $\dfrac{dy}{dx}$ by using parametric differentiation.

(ii) y in terms of x and hence find $\dfrac{dy}{dx}$.

(iii) $\dfrac{d^2y}{dx^2}$ in terms of t.

(12 marks)

(c) Find the derivative of $x^2y + e^{2x}y^2 - 2x = 0$.

(5 marks)

Q4 (a) Integrate $\int_0^{\pi} \sin^2 x \cos^3 x \; dx$.

(9 marks)

(b) Use substitution $t = \tan\left(\dfrac{x}{2}\right)$ and $\tan x = \dfrac{2t}{1-t^2}$ to integrate $\int \dfrac{dx}{\cos x + 1}$.

(5 marks)

(c) Evaluate $\int \dfrac{x \, dx}{\sqrt{16 - x^4}}$ by using trigonometric substitution of $x^2 = 4\sin\theta$.

(6 marks)

Q5 (a) The radius of a circle is increasing at the rate of 5 cm per minute. Find

(i) the rate of change of the area of the circle when its radius is 12cm. [Hint: Area, $A = \pi r^2$]

(ii) the radius of the circle when its area is increasing at a rate of 50π cm^{2}s^{-1}.

(6 marks)

(b) A particle P is moving along the x-axis, such that its displacement x at time t is $x(t) = t^2 - 4t$, where t is measured in seconds and $x(t)$ is measured in meters. Find the acceleration of the particle.

(2 marks)

(c) Evaluate $\int \frac{2x^5 - 5x}{(x^2+2)^2}\,dx$ by using partial fractions.

(12 marks)

- END OF QUESTION -

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Formulae

Indefinite Integrals	Integration of Inverse Functions
$\int x^n dx = \frac{x^{n+1}}{n+1} + C, \quad n \neq -1$	$\int \frac{1}{\sqrt{1-x^2}} dx = \sin^{-1} x + C, \ \lvert x\rvert < 1$
$\int \frac{1}{x} dx = \ln\lvert x\rvert + C$	$\int \frac{-1}{\sqrt{1-x^2}} dx = \cos^{-1} x + C, \ \lvert x\rvert < 1$
$\int \cos x \, dx = \sin x + C$	$\int \frac{1}{1+x^2} dx = \tan^{-1} x + C$
$\int \sin x \, dx = -\cos x + C$	$\int \frac{-1}{1+x^2} dx = \cot^{-1} x + C$
$\int \sec^2 x \, dx = \tan x + C$	$\int \frac{1}{\lvert x\rvert\sqrt{x^2-1}} dx = \sec^{-1} x + C, \ \lvert x\rvert > 1$
$\int \csc^2 x \, dx = -\cot x + C$	$\int \frac{-1}{\lvert x\rvert\sqrt{x^2-1}} dx = \csc^{-1} x + C, \ \lvert x\rvert > 1$
$\int \sec x \tan x \, dx = \sec x + C$	$\int \frac{1}{\sqrt{x^2+1}} dx = \sinh^{-1} x + C$
$\int \csc x \cot x \, dx = -\csc x + C$	$\int \frac{1}{\sqrt{x^2-1}} dx = \cosh^{-1} x + C, \ \lvert x\rvert > 1$
$\int e^x dx = e^x + C$	$\int \frac{-1}{\lvert x\rvert\sqrt{1-x^2}} dx = \text{sech}^{-1} \lvert x\rvert + C, \ 0 < x < 1$
$\int \cosh x \, dx = \sinh x + C$	$\int \frac{-1}{\lvert x\rvert\sqrt{1+x^2}} dx = \text{csch}^{-1} \lvert x\rvert + C, \ x \neq 0$
$\int \sinh x \, dx = \cosh x + C$	$\int \frac{1}{1-x^2} dx = \begin{cases} \tanh^{-1} x + C, & \lvert x\rvert < 1 \\ \coth^{-1} x + C, & \lvert x\rvert > 1 \end{cases}$
$\int \text{sech}^2 x \, dx = \tanh x + C$	
$\int \text{csch}^2 x \, dx = -\coth x + C$	
$\int \text{sech}\, x \tanh x \, dx = -\text{sech}\, x + C$	
$\int \text{csch}\, x \coth x \, dx = -\text{csch}\, x + C$	

TAYLOR AND MACLAURIN SERIES

$$f(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \frac{f'''(a)}{3!}(x-a)^3 + \cdots$$

$$f(x) = f(0) + f'(0)x + \frac{f''(0)}{2!}x^2 + \frac{f'''(0)}{3!}x^3 + \cdots$$

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Formulae

TRIGONOMETRIC SUBSTITUTION

Expression	*Trigonometry*	*Hyperbolic*
$\sqrt{x^2+k^2}$	$x = k\tan\theta$	$x = k\sinh\theta$
$\sqrt{x^2-k^2}$	$x = k\sec\theta$	$x = k\cosh\theta$
$\sqrt{k^2-x^2}$	$x = k\sin\theta$	$x = k\tanh\theta$

TRIGONOMETRIC SUBSTITUTION

$t=\tan\frac{1}{2}x$		$t=\tan x$	
$\sin x = \frac{2t}{1+t^2}$ $\tan x = \frac{2t}{1-t^2}$	$\cos x = \frac{1-t^2}{1+t^2}$ $dx = \frac{2dt}{1+t^2}$	$\sin 2x = \frac{2t}{1+t^2}$ $\tan 2x = \frac{2t}{1-t^2}$	$\cos 2x = \frac{1-t^2}{1+t^2}$ $dx = \frac{dt}{1+t^2}$

IDENTITIES OF TRIGONOMETRY AND HYPERBOLIC

Trigonometric Functions	*Hyperbolic Functions*
$\cos^2 x+\sin^2 x=1$	$\sinh x = \frac{e^x-e^{-x}}{2}$
$\sin 2x = 2\sin x\cos x$	$\cosh x = \frac{e^x+e^{-x}}{2}$
$\cos 2x = \cos^2 x-\sin^2 x$	$\cosh^2 x-\sinh^2 x=1$
$= 2\cos^2 x-1$	$\sinh 2x = 2\sinh x\cosh x$
$= 1-2\sin^2 x$	$\cosh 2x = \cosh^2 x+\sinh^2 x$
$1+\tan^2 x=\sec^2 x$	$= 2\cosh^2 x-1$
$1+\cot^2 x=\csc^2 x$	$= 1+2\sinh^2 x$
$\tan 2x = \frac{2\tan x}{1-\tan^2 x}$	$1-\tanh^2 x = \text{sech}^2 x$
$\tan(x\pm y) = \frac{\tan x\pm\tan y}{1\mp\tan x\tan y}$	$\coth^2 x-1 = \text{csch}^2 x$
$\sin(x\pm y) = \sin x\cos y\pm\sin y\cos x$	$\tanh 2x = \frac{2\tanh x}{1+\tanh^2 x}$
$\cos(x\pm y) = \cos x\cos y\mp\sin x\sin y$	$\tanh(x\pm y) = \frac{\tanh x\pm\tanh y}{1\pm\tanh x\tanh y}$
$2\sin ax\cos bx = \sin(a+b)x+\sin(a-b)x$	$\sinh(x\pm y) = \sinh x\cosh y\pm\sinh y\cosh x$
$2\sin ax\sin bx = \cos(a-b)x-\cos(a+b)x$	$\cosh(x\pm y) = \cosh x\cosh y\pm\sinh x\sinh y$
$2\cos ax\cos bx = \cos(a-b)x+\cos(a+b)x$	