CONFIDENTIAL

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	ENGINEERING MATHEMATICS I
COURSE CODE	:	BEE11303 / BWM10103
PROGRAMME	:	BEJ / BEV
EXAMINATION DATE	:	JUNE / JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

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Q1 (a) Evaluate limit for the following functions:

(i) $\lim_{x\to -1}\frac{x^2+5x+4}{x^4-1}$;

(4 marks)

(ii) $\lim_{x\to 0}\frac{\sqrt{x^2+9}-3}{x^2}$;

(4 marks)

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

(4 marks)

(b) Justify whether the function of $f(x)=(10-x)^{0.5}$ is continuous or not at $x=9$ using relevant evidences.

(4 marks)

(c) Evaluate :

$$\lim_{x\to -2}\frac{\frac{1}{x}+\frac{1}{2}}{x^3+8}$$

(i) Without using L' Hopital rule ;

(5 marks)

(ii) By using L' Hopital rule .

(4 marks)

Q2 (a) Differentiate $y=\frac{(\ln x)^2}{\sqrt{1-\sin(x)}}$

(5 marks)

(b) Given a parametric equation of the curve:

$$x=\frac{1}{1-e^t},\quad y=te^{3t}$$

Find $\frac{dy}{dx}$ in terms of t.

(5 marks)

(c) Find $\frac{dy}{dx}$ for the implicit function $x^m y^n = 2$, where m and n are constants.

(5 marks)

(d) Two resistors of R_1 and R_2 are connected in parallel in a relationship of effective R as follows:

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

R_1 is increasing at the rate of 2 Ω/s and R_2 is decreasing at the rate of 1 Ω/s.

Determine the rate of R when R_1 is 10 Ω and R_2 = 20 Ω.

(10 marks)

Q3 (a) Evaluate $\int_0^2 x\cos(x^2+1)\,dx$ by using substitution of $u = x^2 + 1$.

(6 marks)

(b) Evaluate $\int x^4 \ln x\,dx$ by using integration by part.

(6 marks)

(c) The voltage drops across the capacitor is given by $V_C = \frac{1}{C}\int i(t)\,dt$, where C is capacitance and $i(t)$ is current function. Given C = 1 F and $i(t) = e^{4t}\cos 5t$, calculate V_C.

(6 marks)

(d) Determine $\int \frac{dx}{(x^2+1)^{\frac{3}{2}}}$ by using an appropriate trigonometric substitution.

(7 marks)

Q4 (a) Determine the derivative of $y = \tan^{-1}(e^{\sin x})$.

(6 marks)

(b) Examine the derivative of $y = \sin^{-1}\left(\frac{x}{\sqrt{x^2+1}}\right)$.

(7 marks)

(c) Compute $\int_{\ln 1}^{\ln 3} \frac{e^x dx}{\sqrt{e^{2x}-1}}$.

(6 marks)

(d) Calculate $\int \frac{dx}{x\sqrt{25x^2-2}}$.

(6 marks)

-END OF QUESTIONS-

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Formulae

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

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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

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

IDENTITIES OF TRIGONOMETRY AND HYPERBOLIC

Trigonometric Functions

$$\cos^2 x + \sin^2 x = 1$$
$$\sin 2x = 2\sin x\cos x$$
$$\cos 2x = \cos^2 x - \sin^2 x$$
$$= 2\cos^2 x - 1$$
$$= 1 - 2\sin^2 x$$
$$1 + \tan^2 x = \sec^2 x$$
$$1 + \cot^2 x = \csc^2 x$$
$$\tan 2x = \frac{2\tan x}{1-\tan^2 x}$$
$$\tan(x \pm y) = \frac{\tan x \pm \tan y}{1 \mp \tan x\tan y}$$
$$\sin(x \pm y) = \sin x\cos y \pm \sin y\cos x$$
$$\cos(x \pm y) = \cos x\cos y \mp \sin x\sin y$$
$$2\sin ax\cos bx = \sin(a+b)x + \sin(a-b)x$$
$$2\sin ax\sin bx = \cos(a-b)x - \cos(a+b)x$$
$$2\cos ax\cos bx = \cos(a-b)x + \cos(a+b)x$$

Hyperbolic Functions

$$\sinh x = \frac{e^x - e^{-x}}{2}$$
$$\cosh x = \frac{e^x + e^{-x}}{2}$$
$$\cosh^2 x - \sinh^2 x = 1$$
$$\sinh 2x = 2\sinh x\cosh x$$
$$\cosh 2x = \cosh^2 x + \sinh^2 x$$
$$= 2\cosh^2 x - 1$$
$$= 1 + 2\sinh^2 x$$
$$1 - \tanh^2 x = \text{sech}^2 x$$
$$\coth^2 x - 1 = \text{csch}^2 x$$
$$\tanh 2x = \frac{2\tanh x}{1+\tanh^2 x}$$
$$\tanh(x \pm y) = \frac{\tanh x \pm \tanh y}{1 \pm \tanh x\tanh y}$$
$$\sinh(x \pm y) = \sinh x\cosh y \pm \sinh y\cosh x$$
$$\cosh(x \pm y) = \cosh x\cosh y \pm \sinh x\sinh y$$