UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	ENGINEERING MATHEMATICS I
COURSE CODE	:	BEE11303 / BWM10103
PROGRAMME	:	BEJ / BEV
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Find the derivatives of the following functions with respect to x:

(i) $y = \frac{e^x}{\sinh 2x}$;

(7 marks)

(ii) $y = \ln(\tanh x^2)$;

(6 marks)

(iii) $y = x \sin^{-1} x + \sqrt{1 - x^2}$;

(6 marks)

(iv) $y = (1 - x) \coth^{-1} \sqrt{x}$;

(6 marks)

Q2 (a) Evaluate the following integrals:

(i) $\int cosh^2 (5x + 2) dx$;

(6 marks)

(ii) $\int e^{3x} \cosh 2x \, dx$;

(6 marks)

(iii) $\int \frac{dx}{|x|\sqrt{4x^2 - 5}}$;

(6 marks)

(iv) $\int_0^1 \sinh^{-1} x \, dx$;

(7 marks)

Q3 (a) Find the integration of the following functions:

(i) $\int \frac{x^2 + 2}{x + 2} dx$

(4 marks)

(ii) $\int \sin 3x \cos 4x dx$ using tabular method

(4 marks)

(iii) $\int x^3 \sin(x^2)dx$

(8 marks)

(iv) $\int \frac{5x^2+20x+6}{x^3+2x^2+x}dx$

(9 marks)

Q4 (a) Evaluate each of the following integrals.

(i) $\int \frac{\cos^5\theta}{\sin^4\theta}d\theta$

(6 marks)

(ii) $\int \sin^4\theta\cos^4\theta\, d\theta$

(6 marks)

(iii) $\int \frac{dx}{\sqrt{4x^2+9}}$ (hint: use trigonometric substitution)

(6 marks)

(b) (i) Given that the voltage $v(t)$ across a 5 mH inductor is 1.5 cos (200t), and the current is zero at time $t = 0$ s. Find the current $i(t)$ passes through the inductor, if $i(t) = \frac{1}{L}\int v(t)dt$

(3 marks)

(ii) Based on the integrator circuit in Figure Q4 (b)(i), draw the ideal output voltage of the circuit for each of the following input voltage waveforms in Figure Q4 (b)(ii) and Figure Q4 (b)(iii).

(4 marks)

-END OF QUESTIONS-

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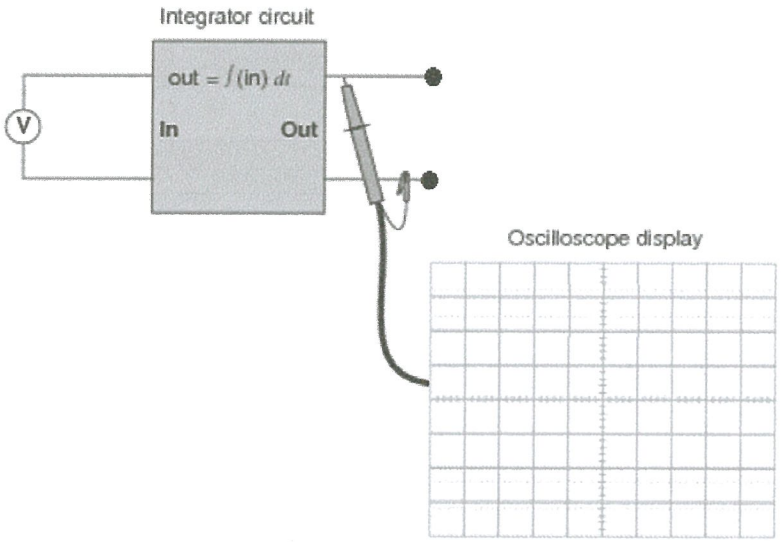

Figure Q4 (b)(i)

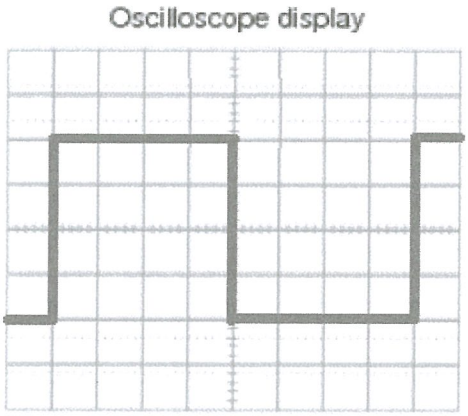

Figure Q4 (b)(ii)

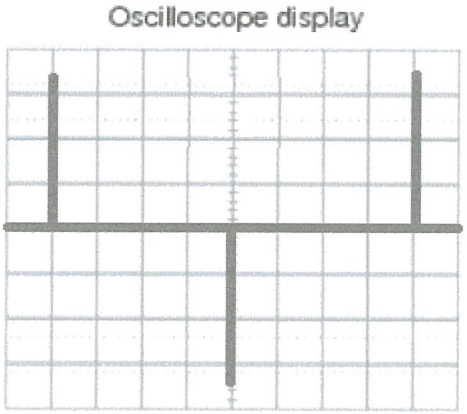

Figure Q4 (b)(iii)

Note: Please use Figure Q4 (b)(ii) and Figure 4 Q4 (b)(iii) to draw the output waveforms

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Formulae

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

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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

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

IDENTITIES OF TRIGONOMETRY AND HYPERBOLIC

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