Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	MATHEMATICS FOR ENGINEERING TECHNOLOGY I
COURSE CODE	:	BWM 12203
PROGRAMME CODE	:	BNA / BNB / BNC / BND / BNE / BNF / BNG / BNL / BNM / BNN / BNT
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

TERBUKA

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

Q1 (a) Evaluate the following limits if exist.

(i) $\lim_{x\to\infty} x^2 e^{-3x}$.

(3 marks)

(ii) $\lim_{x\to 1} \dfrac{\sin(1-\sqrt{x})}{x-1}$.

(3 marks)

(iii) $\lim_{x\to 1} \dfrac{1}{\ln x} - \dfrac{1}{x-1}$.

(4 marks)

(iv) $\lim_{x\to\infty} 3x - \sqrt{x^4 - 2x + 3}$.

(5 marks)

(b) Find the values of x so that the given function below is discontinuous.

$$f(x) = \frac{x^2 - 16}{x^2 - 5x + 4}.$$

(4 marks)

(c) Given the following function,

$$f(x) = \begin{cases} \left(\dfrac{x+5}{x}\right)^3, & 0 < x < 5; \\ 8, & x = 5; \\ \sqrt{x^2 + 24} + 1, & 5 < x < 10. \end{cases}$$

Determine whether $f(x)$ is continuous or not at $x = 5$.

(6 marks)

TERBUKA

Q2 (a) Calculate $\frac{d^2y}{dx^2}$ if given the parametric equation $x = 1 - 3\sin(4\pi t)$ and $y = 2 + 3\cos(4\pi t)$.

(7 marks)

(b) Compute $\frac{dy}{dx}$ if $\frac{y^4 + x^4}{x^3 y^3} = x^2 y^4$ by using implicit differentiation.

(8 marks)

(c) By using logarithmic differentiation, find $\frac{dy}{dx}$ for

$$y = \frac{(x^2 + 8)^{\sin x}}{4(\sqrt[3]{1 - 9x}).(20)^{x-2}}.$$

(10 marks)

Q3 (a) Evaluate

(i) $\displaystyle\int_0^{\pi/2} \frac{dx}{1 + \sin x + \cos x}.$

(6 marks)

(ii) $\displaystyle\int \sin^5\left(\frac{x}{3}\right) dx.$

(8 marks)

(b) Solve $\displaystyle\int \frac{x+1}{x^3 + 6x^2 + 9x} dx.$

(11 marks)

Q4 (a) Determine whether each of the following series converges or diverges by using the appropriate test.

(i) $\displaystyle\sum_{n=0}^{\infty} \frac{1}{(n+1)^4}.$

(3 marks)

(ii) $\displaystyle\sum_{n=1}^{\infty} \frac{100^n}{n!}.$

TERBUKA

(3 marks)

(iii) $\sum_{n=1}^{\infty}\left(\frac{n+1}{n}\right)^{n^2}$.

(3 marks)

(b) (i) Obtain the Maclaurin series for $f(x) = \cos x$ up to three non-zero terms. Write your answer in summation $\left(\sum_{k=0}^{\infty}\right)$ form.

(6 marks)

(ii) Hence, approximate $\int_0^1 \cos(x^2)\,dx$ to three decimal places.

(5 marks)

(c) Find the Taylor series expansion of $f(x) = e^{5x}$ at point $x = 1$.

(5 marks)

– END OF QUESTIONS –

TERBUKA

FINAL EXAMINATION

SEMESTER/SESSION : SEM I/2019/2020

PROGRAMME CODE : BNA / BNB / BNC / BND / BNE / BNF / BNG / BNL / BNM / BNN / BNT

COURSE NAME : MATHEMATICS FOR ENGINEERING TECHNOLOGY I

COURSE CODE : BWM 12203

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

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

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

TERBUKA

TERBUKA

FINAL EXAMINATION

SEMESTER/SESSION : SEM I/2019/2020

PROGRAMME CODE : BNA / BNB / BNC / BND / BNE / BNF / BNG / BNL / BNM / BNN / BNT

COURSE NAME : MATHEMATICS FOR ENGINEERING TECHNOLOGY I

COURSE CODE : BWM 12203

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

$\cos^2 x+\sin^2 x=1$

$\sin 2x=2\sin x\cos x$

$\cos 2x=\cos^2 x-\sin^2 x$

$=2\cos^2 x-1$

$=1-2\sin^2 x$

$1+\tan^2 x=\sec^2 x$

$1+\cot^2 x=\csc^2 x$

$\tan 2x=\dfrac{2\tan x}{1-\tan^2 x}$

$\tan(x\pm y)=\dfrac{\tan x\pm\tan y}{1\mp\tan x\tan y}$

$\sin(x\pm y)=\sin x\cos y\pm\sin y\cos x$

$\cos(x\pm y)=\cos x\cos y\mp\sin x\sin y$

$2\sin ax\cos bx=\sin(a+b)x+\sin(a-b)x$

$2\sin ax\sin bx=\cos(a-b)x-\cos(a+b)x$

Hyperbolic Functions

$\sinh x=\dfrac{e^x-e^{-x}}{2}$

$\cosh x=\dfrac{e^x+e^{-x}}{2}$

$\cosh^2 x-\sinh^2 x=1$

$\sinh 2x=2\sinh x\cosh x$

$\cosh 2x=\cosh^2 x+\sinh^2 x$

$=2\cosh^2 x-1$

$=1+2\sinh^2 x$

$1-\tanh^2 x=\text{sech}^2 x$

$\coth^2 x-1=\text{csch}^2 x$

$\tanh 2x=\dfrac{2\tanh x}{1+\tanh^2 x}$

$\tanh(x\pm y)=\dfrac{\tanh x\pm\tanh y}{1\pm\tanh x\tanh y}$

$\sinh(x\pm y)=\sinh x\cosh y\pm\sinh y\cosh x$

TERBUKA