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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	CALCULUS
COURSE CODE	:	BFC 15003
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JANUARY / FEBRUARY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ALL QUESTION.
		2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSE BOOK**.

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

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Q1 (a) Find the derivatives of $y = (8x + 5)^{12}\ (x^3 + 7)^{13}$.

(5 marks)

(b) Differentiate the equation $x^3 - 5y^4 = 7x^2 - 3y + 6$ with respect to x.

(4 marks)

(c) Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ of the following equations of a curve, given by:

$$x = t^2, \quad y = t^5 - 2t^3 + 1$$

(6 marks)

(d) **Figure Q1** shows a cube. The side of a cube is increasing at the rate of 5cms^{-1}. Find the rate of increase of the volume when the length of a side is 3cm.

(5 marks)

Q2 (a) Find the intervals where function is increasing and decreasing from this equation:

$$f(x) = x^3 - 9x^2 + 24x.$$

(4 marks)

(b) **Figure Q2 (b)** shows an open – top box. The box is to have a square base and a volume of 10 m^3. Let x and y be the box's width and height respectively.

(i) Show that the surface area of the box is:

$$S = x^2 + \frac{40}{x}$$

(5 marks)

(ii) Find the minimum surface area of the box, where:

$$S = x^2 + \frac{40}{x} = x^2 + 40x^{-1}$$

(5 marks)

(c) Mr. Musa has (xy) m^2 of vacant land next to his tall building beside as shown in **Figure Q2 (c).** Every day, people used to park their cars on Mr Musa's vacant land without his permission. So, he plans to put up a security fence around the vacant land. A rectangular storage area is to be put along the side of the tall building. A security fence is required along the remaining 3 sides of the area. Determine the maximum area that can be enclosed with 800m of fencing.

(6 marks)

Q3 (a) Solve the following differential equation:

$$\frac{dy}{dx} = \frac{2y}{x} + \cos\left(\frac{y}{x^2}\right)$$

(5 marks)

(b) Show how this statement $\frac{4x^4+5x^2-9}{(2x-1^2)(x+2)}$,

(i) Can be proven as $x - 1 + \frac{A}{2x-1} + \frac{B}{(2x-1)^2} + \frac{C}{x+2}$.

(5 marks)

(ii) Determine the values of A, B and C in **Q3 (b) (i).**

(6 marks)

(c) By using integration by parts, show that:

$$\int \frac{(x+2)e^x}{\sqrt{e^x+1}}dx = 2(x+1)\sqrt{e^x}+1 - \int \frac{e^x+2}{\sqrt{e^x+1}}dx$$

(4 marks)

Q4 (a) Find the area bounded by the curves $y = \sin x$ and $y = \cos x$ for $0 < x < 2\pi$ by considering the curves intersect only.

(5 marks)

(b) Find the area of the region in the first quadrant enclosed by the curve $y = \tan x\,(\sqrt{3} - \tan x)$ and the x-axis.

(5 marks)

(c) M is the region in the first quadrant enclosed by the curve $y = 4 - (x+1)^2$ with the axes. Meanwhile, N is the region enclosed by the curve $y = 4 - (x+1)^2$, the lines $x = 1$ and $y = 3$.

(i) Based on the information given, illustrate the area of region M in a graph.

(3 marks)

(ii) V_1 and V_2 represent the volumes of the solid generated by rotating the region M through 2π radians about the x-axis and the y-axis respectively. Prove that $V_1 : V_2 = 106:35$.

(4 marks)

(iii) Find the volume of the solid generated, if the region N is rotated through 2π radians about the y-axis.

(3 marks)

Q5 (a) A total of 10 squirrels are captured randomly from an oil palm plantation and kept to breed in an experimental laboratory. After a month, the number of squirrels has increased by 5. The rate of increase per month of the squirrel population is given by the differential equation $\frac{dx}{dt} = kx\,(40 - x)$, where x is the population of squirrels at time t and k is a constant.

(i) Express the population of squirrels in terms of $time$.

(8 marks)

(ii) Calculate the number of squirrels after a period of two years.

(2 marks)

(b) In a training practice, a parachutist jumps off an aeroplane. When his parachute opens, he descends vertically downward with an initial velocity of $\frac{1}{3}\sqrt{\frac{g}{k}}$, where g and k are positive constants. The velocity, v, of the parachutist at time, t, is given by the differential equation $v\frac{dv}{dt} = g - kv^2$. Derive equation in term of g and k for the following:

(i) $v^2 = \frac{g}{9k}(9 - 8e^{-2kt})$;

(6 marks)

(ii) Time taken by the parachutist to attain a velocity of $\frac{1}{2}\sqrt{\frac{g}{k}}$;

(2 marks)

(iii) The velocity of the parachutist after a very long period of time.

(2 marks)

– END OF QUESTIONS –

FINAL EXAMINATION

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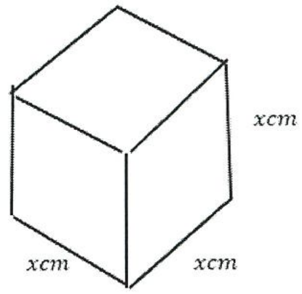

FIGURE Q1

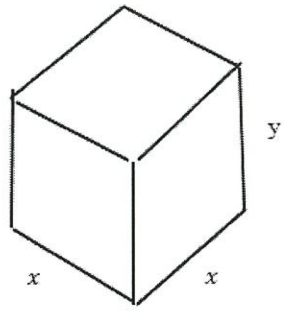

FIGURE Q2 (b)

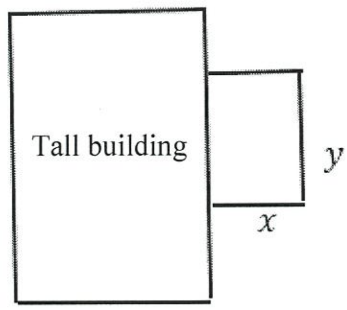

FIGURE Q2 (c)

FINAL EXAMINATION

SEMESTER/SESSION : SEM I 2021/2022
COURSE NAME : CALCULUS
PROGRAMME CODE : BFF
COURSE CODE : BFC 15003

Formula

Differentiation Rules	Indefinite Integrals
$\frac{d}{dx}[k]=0$	$\int k\,dx = kx + C$
$\frac{d}{dx}[x^n]=nx^{n-1}$	$\int x^n dx = \frac{x^{n+1}}{n+1}+C, \quad n \neq -1$
$\frac{d}{dx}[\ln\|x\|]=\frac{1}{x}$	$\int \frac{dx}{x} = \ln\|x\| + C$
$\frac{d}{dx}[\cos x]=-\sin x$	$\int \sin x\,dx = -\cos x + C$
$\frac{d}{dx}[\sin x]=\cos x$	$\int \cos x\,dx = \sin x + C$
$\frac{d}{dx}[\tan x]=\sec^2 x$	$\int \sec^2 x\,dx = \tan x + C$
$\frac{d}{dx}[\cot x]=-\text{cosec}^2 x$	$\int \text{cosec}^2 x\,dx = -\cot x + C$
$\frac{d}{dx}[\sec x]=\sec x \tan x$	$\int \sec x \tan x\,dx = \sec x + C$
$\frac{d}{dx}[\text{cosec}\,x]=-\text{cosec}\,x \cot x$	$\int \text{cosec}\,x \cot x\,dx = -\text{cosec}\,x + C$
$\frac{d}{dx}[e^x]=e^x$	$\int e^x\,dx = e^x + C$
$\frac{d}{dx}[\cosh x]=\sinh x$	$\int \sinh x\,dx = \cosh x + C$
$\frac{d}{dx}[\sinh x]=\cosh x$	$\int \cosh x\,dx = \sinh x + C$
$\frac{d}{dx}[\tanh x]=\text{sech}^2 x$	$\int \text{sech}^2 x\,dx = \tanh x + C$
$\frac{d}{dx}[\coth x]=-\text{cosech}^2 x$	$\int \text{cosech}^2 x\,dx = -\coth x + C$
$\frac{d}{dx}[\text{sech}\,x]=-\text{sech}\,x \tanh x$	$\int \text{sech}\,x \tanh x\,dx = -\text{sech}\,x + C$
$\frac{d}{dx}[\text{cosech}\,x]=-\text{cosech}\,x \coth x$	$\int \text{cosech}\,x \coth x\,dx = -\text{cosech}\,x + C$

FINAL EXAMINATION

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PROGRAMME CODE : BFF
COURSE CODE : BFC 15003

Formula

Trigonometric	Hyperbolic
$\cos^2 x + \sin^2 x = 1$	$\sinh x = \dfrac{e^x - e^{-x}}{2}$
$1 + \tan^2 x = \sec^2 x$	$\cosh x = \dfrac{e^x + e^{-x}}{2}$
$\cot^2 x + 1 = \csc^2 x$	$\cosh^2 x - \sinh^2 x = 1$
$\sin 2x = 2\sin x \cos x$	$1 - \tanh^2 x = \operatorname{sech}^2 x$
$\cos 2x = \cos^2 x - \sin^2 x$	$\coth^2 x - 1 = \operatorname{csch}^2 x$
$\cos 2x = 2\cos^2 x - 1$	$\sinh 2x = 2\sinh x \cosh x$
$\cos 2x = 1 - 2\sin^2 x$	$\cosh 2x = \cosh^2 x + \sinh^2 x$
$\tan 2x = \dfrac{2\tan x}{1 - \tan^2 x}$	$\cosh 2x = 2\cosh^2 x - 1$
$\sin(x \pm y) = \sin x \cos y \pm \cos x \sin y$	$\cosh 2x = 1 + 2\sinh^2 x$
$\cos(x \pm y) = \cos x \cos y \mp \sin x \sin y$	$\tanh 2x = \dfrac{2\tanh x}{1 + \tanh^2 x}$
$\tan(x \pm y) = \dfrac{\tan x \pm \tan y}{1 \mp \tan x \tan y}$	$\sinh(x \pm y) = \sinh x \cosh y \pm \cosh x \sinh y$
$2\sin x \cos y = \sin(x+y) + \sin(x-y)$	$\cosh(x \pm y) = \cosh x \cosh y \pm \sinh x \sinh y$
$2\sin x \sin y = -\cos(x+y) + \cos(x-y)$	$\tanh(x \pm y) = \dfrac{\tanh x \pm \tanh y}{1 \pm \tanh x \tanh y}$
$2\cos x \cos y = \cos(x+y) + \cos(x-y)$	**Inverse Hyperbolic**
Logarithm	$\sinh^{-1} x = \ln\left(x + \sqrt{x^2+1}\right)$, any x
$a^x = e^{x \ln a}$	$\cosh^{-1} x = \ln\left(x + \sqrt{x^2-1}\right)$, $x \geq 1$
$\log_a x = \dfrac{\log_b x}{\log_b a}$	$\tanh^{-1} x = \dfrac{1}{2}\ln\left(\dfrac{1+x}{1-x}\right)$, $-1 < x < 1$

FINAL EXAMINATION

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PROGRAMME CODE : BFF
COURSE CODE : BFC 15003

Formula

Integration of Inverse Functions
$\int \frac{dx}{\sqrt{a^2 - x^2}} = \sin^{-1}\left(\frac{x}{a}\right) + C$
$\int \frac{dx}{a^2 + x^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + C$
$\int \frac{dx}{\lvert a \rvert \sqrt{a^2 - x^2}} = \frac{1}{a}\sec^{-1}\left(\frac{x}{a}\right) + C$
$\int \frac{dx}{\sqrt{x^2 + a^2}} = \sinh^{-1}\left(\frac{x}{a}\right) + C, \quad a > 0$
$\int \frac{dx}{\sqrt{x^2 - a^2}} = \cosh^{-1}\left(\frac{x}{a}\right) + C, \quad x > a$
$\int \frac{dx}{x^2 - a^2} = \begin{cases} \frac{1}{a}\tanh^{-1}\left(\frac{x}{a}\right) + C, & \lvert x \rvert < a \\ \frac{1}{a}\coth^{-1}\left(\frac{x}{a}\right) + C, & \lvert x \rvert > a \end{cases}$
$\int \frac{dx}{x\sqrt{a^2 - x^2}} = -\frac{1}{a}\text{sech}^{-1}\left(\frac{x}{a}\right) + C, \quad 0 < x < a$
$\int \frac{dx}{x\sqrt{a^2 + x^2}} = -\frac{1}{a}\text{cosech}^{-1}\left(\frac{x}{a}\right) + C, \quad 0 < x < a$

FINAL EXAMINATION

SEMESTER/SESSION : SEM I 2021/2022
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COURSE CODE : BFC 15003

Formula

Differentiation of Inverse Functions	
y	$\frac{dy}{dx}$
$\sin^{-1} u$	$\frac{1}{\sqrt{1-u^2}}\frac{du}{dx}, \quad \lvert u\rvert < 1$
$\cos^{-1} u$	$-\frac{1}{\sqrt{1-u^2}}\frac{du}{dx}, \quad \lvert u\rvert < 1$
$\tan^{-1} u$	$\frac{1}{1+u^2}\frac{du}{dx}$
$\cot^{-1} u$	$-\frac{1}{1+u^2}\frac{du}{dx}$
$\sec^{-1} u$	$\frac{1}{\lvert u\rvert\sqrt{u^2-1}}\frac{du}{dx}, \quad \lvert u\rvert > 1$
$\operatorname{cosec}^{-1} u$	$-\frac{1}{\lvert u\rvert\sqrt{u^2-1}}\frac{du}{dx}, \quad \lvert u\rvert > 1$
$\sinh^{-1} u$	$\frac{1}{\sqrt{u^2+1}}\frac{du}{dx}$
$\cosh^{-1} u$	$\frac{1}{\sqrt{u^2-1}}\frac{du}{dx}, \quad \lvert u\rvert > 1$
$\tanh^{-1} u$	$\frac{1}{1-u^2}\frac{du}{dx}, \quad \lvert u\rvert < 1$
$\coth^{-1} u$	$-\frac{1}{1-u^2}\frac{du}{dx}, \quad \lvert u\rvert > 1$
$\operatorname{sech}^{-1} u$	$-\frac{1}{u\sqrt{1-u^2}}\frac{du}{dx}, \quad 0 < u < 1$
$\operatorname{cosech}^{-1} u$	$-\frac{1}{\lvert u\rvert\sqrt{1+u^2}}\frac{du}{dx}, \quad u \neq 0$

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COURSE NAME : CALCULUS COURSE CODE : BFC 15003

Formula

Area between two curves

Case 1- Integrating with respect to *x*: $A = \int_a^b [f(x) - g(x)]dx$

Case 2- Integrating with respect to *y*: $A = \int_c^d [f(y) - g(y)]dy$

Area of surface of revolution

Case 1- Revolving the portion of the curve about *x*-axis: $S = 2\pi \int_a^b y\sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx$

Case 2- Revolving the portion of the curve about *y*-axis: $S = 2\pi \int_c^d x\sqrt{1 + \left(\frac{dx}{dy}\right)^2}\, dy$

Parametric curve- Revolving the curve about *x*-axis: $S = 2\pi \int_a^b y\sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt$

Parametric curve- Revolving the curve about *y*-axis: $S = 2\pi \int_c^d x\sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt$

Arc length

x-axis: $L = \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx$

y-axis: $L = \int_c^d \sqrt{1 + \left(\frac{dx}{dy}\right)^2}\, dy$

Parametric curve: $L = \int_a^b \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt$

Curvature

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

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

Curvature of parametric curve

Curvature, $\kappa = \dfrac{|\dot{x}\ddot{y}-\dot{y}\ddot{x}|}{(\dot{x}^2+\dot{y}^2)^{3/2}}$

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

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FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	BUILT AND NATURAL HERITAGE
COURSE CODE	:	BFR 22802
PROGRAMME CODE	:	BFR
EXAMINATION DATE	:	JANUARY / FEBRUARY 2022
DURATION	:	2 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **CLOSE BOOK**.

THIS QUESTION PAPER CONSISTS OF **THREE (3)** PAGES

Q1 (a) State the meaning of heritage and its importance in the architectural.

(6 marks)

(b) Define the meaning of world heritage sites and namely **TWO (2)** in Malaysia.

(4 marks)

(c) The concept of heritage is invariably and explained by UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (1972). How you determine our cultural heritage by the UNESCO classifications.

(15 marks)

Q2 (a) According to the Act, cultural heritage divided into two aspects which is tangible and intangible form of cultural property. State the differences and give examples.

(6 marks)

(b) Many potential areas in our country able to classified as heritage. Give an opinion of how potential heritage buildings can be considered on a declaration of National Heritage property according to the National Heritage Act 2005, Section 67.

(19 marks)

Q3 (a) Conservation is a step towards promoting Southeast Asia as a cultural heritage and become an important tourism asset for our country.

(i) Namely **FOUR (4)** Act and **THREE (3)** statutory bodies that control Malaysia conservation activities.

(7 marks)

(ii) In point of your views, how conservation able to contribute to the country development sectors (economy and education).

(8 marks)

(iii) There are many obstacles facing the sustainability of multi-cultural heritage of Southeast Asia. Discuss the issues and challenges in these matters.

(10 marks)

Q4 (a) Historic relics is the area needs to be preserved and maintained for future generations to appreciate. Various conservation terminologies have been identified. Explain your understanding of the terms below.

(i) Authenticity

(ii) Consolidation

(iii) Stabilization

(iv) Retrofitting

(v) Revitalization

(15 marks)

(b) Wooden houses are famous as the traditional architectural heritage of the Malay region. However, the usage of wood as building material is declining. State your views on how to remain the design of old Malay houses today.

(10 marks)

-END OF QUESTIONS-