UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	ENGINEERING MATHEMATICS I
COURSE CODE	:	DAS 10303
PROGRAMME CODE	:	DAE
EXAMINATION DATE	:	JUNE/JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN SECTION A AND **THREE(3)** QUESTIONS IN SECTION B.

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

SECTION A

Q1 (a) Find the inverse of the following Laplace transform.

(i) $\dfrac{s}{s^2-4}$.

(1 mark)

(ii) $\dfrac{6}{2s^2-18}+\dfrac{4s}{4s^2+16}$.

(3 marks)

(iii) $\dfrac{2}{s}+\dfrac{3}{s+3}+\dfrac{4}{s^2+16}-\dfrac{8}{s^4}$.

(4 marks)

(iv) $\dfrac{-4}{(s-4)^2}-\dfrac{s+5}{s^2+6s+13}$.

(5 marks)

(b) Find the inverse Laplace of equation below by using partial fraction $\dfrac{3s+16}{(s^2-s-6)(s-1)}$.

(7 marks)

Q2 Solve the given initial value problem below by using Laplace transform.

(a) $y''+y=e^t;\ y(0)=0,\ y'(0)=0$.

(9 marks)

(b) $y''+y'-2y=4;\ y(0)=2,\ y'(0)=1$.

(11 marks)

SECTION B

Q3 (a) Given a set of ordered pairs, $A=\{(2,13),(3,28),(5,76),(7,148)\}$.

(i) State the domain and range of A.

(2 marks)

(ii) Determine the relation of set A, either $y=2x^3-3$ or $y=3x^2+1$.

(4 marks)

(b) (i) Given a graph of a function, $y=f(x)$ in **Figure Q3(b)**, find $f(-3)$, $f(0)$, $f(4)$, and $f(6)$.

(4 marks)

(ii) Given a piecewise function, $g(x)=\begin{cases}3x-7 & , \quad x<2\\ 11-x^2 & , \quad 2\le x<5\\ \frac{2}{5}x+1 & , \quad 5\le x\le 10\end{cases}$, sketch the graph of $g(x)$.

(4 marks)

(c) (i) Find the inverse of $h(x)=\ln(5x-2)$.

(3 marks)

(ii) Given $f(x)=\dfrac{1}{x-1}$ and $g(x)=\dfrac{x+1}{x-1}$. Find $(f\circ g)(x)$.

(3 marks)

Q4 (a) By referring to the **Figure Q4(a),** find

(i) $\lim\limits_{x\to -4} f(x)$.

(3 marks)

(ii) $\lim\limits_{x\to -1} f(x)$.

(3 marks)

(iii) Discuss whether the function given is continuous at $x=2$.

(3 marks)

(b) Evaluate

(i) $\lim\limits_{x\to 4}\dfrac{x^2-10x+24}{x^2-x-12}$.

(3 marks)

(ii) $\lim\limits_{x\to 3}\dfrac{\sqrt{x^2+16}-5}{x^2-9}$.

(4 marks)

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(c) Given $f(x)=\begin{cases} x+3 & , \quad x<1 \\ ax^2+b & , \quad 1\le x<2. \\ -2x+2 & , \quad x\ge 2 \end{cases}$

If $f(x)$ is a continuous function, find the values of a and b.

(4 marks)

Q5 (a) Find the derivatives of the following function.

(i) $y=\frac{3}{5}x^5+\frac{e}{2}-\frac{1}{x+1}$.

(3 marks)

(ii) $y=\frac{3x^2+2x^3+3}{2\pi}$.

(2 marks)

(iii) $y=e^{2x}\ln(\sin x)$.

(3 marks)

(b) Given $f(x)=\frac{4\sin x}{2x+\cos x}$. Find and simplify $f'(x)$. Hence find $f'(0)$.

[Hint: $\sin^2 x+\cos^2 x=1$]

(7 marks)

(c) Use Implicit differentiation to find the gradient of the tangent to the curve $3x^2-2xy=y^{\frac{1}{2}}-\cos x$.

(5 marks)

Q6 (a) A conical water tank filled with water has the radius of $r\ cm$ at the top and $h\ cm$ height where the height of the water is twice the radius. Water flows out the tank at a rate of $10\ cm^3s^{-1}$. Find the rate at which the radius of the water is changing at an instant when the height of water is $4\ cm$.

[Hint: $V=\frac{2}{3}\pi r^3$]

(4 marks)

(b) Given a function $f(x)=\frac{1}{3}x^3+\frac{1}{2}x^2-20x+6$.

(i) Find $f'(x)$, $f''(x)$, a, b, and complete the **Table Q6(b)(i)**.

(9 marks)

(ii) Sketch the graph of $f(x)$.

(3 marks)

(c) Calculate the following limits by using L'Hospital's Rule.

(i) $\lim_{x \to 7} \frac{x^2 - 2x - 35}{3x - 21}$.

(2 marks)

(ii) $\lim_{x \to \infty} \frac{3x^3 + 2x^2 - 5x + 7}{4x^2 - 6x - 5}$.

(2 marks)

Q7 (a) Find the Laplace Transform for the following function.

(i) $f(t) = 3t^2 + 3\cos 3t$.

(3 marks)

(ii) $f(t) = \cosh 2t + 3 + 2e^{-3t}$.

(4 marks)

(iii) $f(t) = e^t \sin 4t + t^2 \cos 5t$.

(7 marks)

(b) Find the Inverse Laplace Transform of $\frac{2s - 3}{s^2 + 3s - 10}$ by using partial fraction.

(6 marks)

-END OF QUESTIONS-

FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 / 2017/2018
COURSES : ENGINEERING MATHEMATICS I

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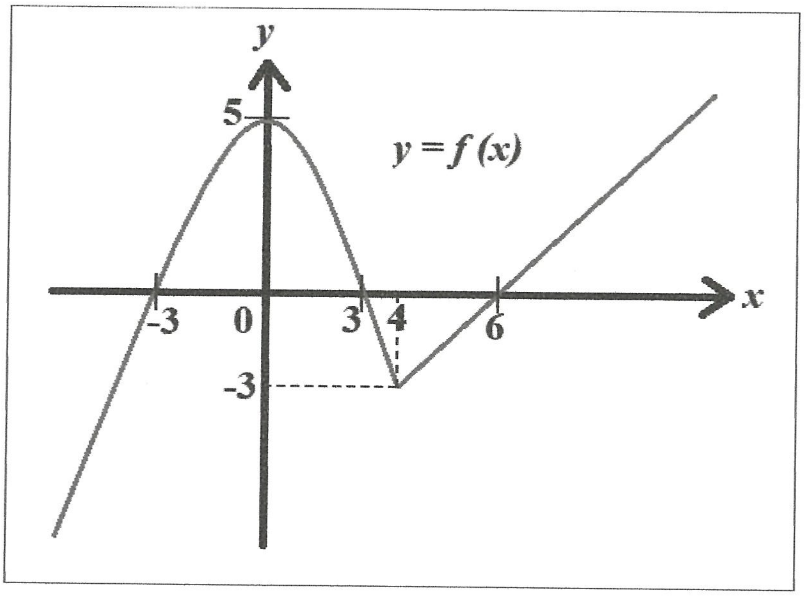

Figure Q3(b)

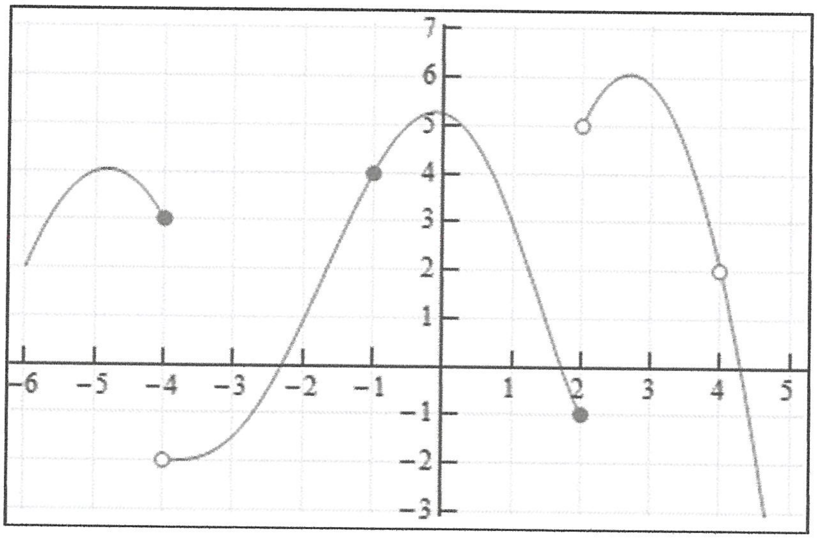

Figure Q4(a)

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FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 / 2017/2018 PROGRAMME : DAE
COURSES : ENGINEERING MATHEMATICS I COURSES CODE : DAS 10303

Table Q6(b)(i)

Area	$x < a$	$a < x < -\frac{1}{2}$	$-\frac{1}{2} < x < b$	$x > b$
Test value	-10		0	5
f'				
f''				
Slope				
Concavity				
Shape of f				

FINAL EXAMINATION

SEMESTER / SESSION : SEM 2 / 2017/2018
COURSES : ENGINEERING MATHEMATICS I
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Formulae

Table 1: Differentiation

$\frac{d}{dx}[c]=0$	$\frac{d}{dx}[\sin u]=\cos u\left(\frac{du}{dx}\right)$
$\frac{d}{dx}[x^n]=nx^{n-1}$	$\frac{d}{dx}[\cos u]=-\sin u\left(\frac{du}{dx}\right)$
$\frac{d}{dx}[cu]=c\frac{du}{dx}$	$\frac{d}{dx}[\ln\|u\|]=\frac{1}{u}\left(\frac{du}{dx}\right)$
$\frac{d}{dx}[u\pm v]=\frac{du}{dx}\pm\frac{dv}{dx}$	$\frac{d}{dx}\left[e^u\right]=e^u\left(\frac{du}{dx}\right)$
$\frac{d}{dx}[uv]=u\frac{dv}{dx}+v\frac{du}{dx}$	$\frac{d}{dx}[a^u]=a^u\ln a\left(\frac{du}{dx}\right)$
$\frac{d}{dx}\left[\frac{u}{v}\right]=\frac{v\frac{du}{dx}-u\frac{dv}{dx}}{v^2}$	$\frac{d}{dx}[\tan u]=\sec^2 u\left(\frac{du}{dx}\right)$
$\frac{d}{dx}[\log_a u]=\frac{1}{u}\log_b e\left(\frac{du}{dx}\right)$	$\frac{d}{dx}[\sec u]=\sec u\tan u\left(\frac{du}{dx}\right)$
Chain Rule: $\frac{dy}{dx}=\frac{dy}{du}.\frac{du}{dx}$	Parametric Differentiation: $\frac{dy}{dx}=\frac{dy}{dt}.\frac{dt}{dx}$

FINAL EXAMINATION

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Table 2: Laplace and Inverse Laplace Transforms

$L\{f(t)\}=\int_0^\infty f(t)e^{-st}dt=F(s)$	
$f(t)$	$F(s)$
k	$\frac{k}{s}$
$t^n, n=1,2,\ldots$	$\frac{n!}{s^{n+1}}$
e^{at}	$\frac{1}{s-a}$
$\sin at$	$\frac{a}{s^2+a^2}$
$\cos at$	$\frac{s}{s^2+a^2}$
$\sinh at$	$\frac{a}{s^2-a^2}$
$\cosh at$	$\frac{s}{s^2-a^2}$
The First Shift Theorem	
$e^{at}f(t)$	$F(s-a)$
Multiply with t^n	
$t^n f(t), n=1,2,\ldots$	$(-1)^n \frac{d^n F(s)}{ds^n}$
Initial Value Problem	
$L\{y(t)\}=Y(s)$	
$L\{y'(t)\}=sY(s)-y(0)$	
$L\{y''(t)\}=s^2Y(s)-sy(0)-y'(0)$	

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