UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	ENGINEERING MATHEMATICS I
COURSE CODE	:	DAS 10303
PROGRAMME	:	DAE
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	SECTION A) ANSWER **ALL** QUESTIONS SECTION B) ANSWER **THREE (3)** QUESTIONS ONLY

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

SECTION A

Q1 (a) Find the Inverse Laplace transform for the functions below.

(i) $F(s)=\dfrac{2017}{s}$.

(1 mark)

(ii) $F(s)=\dfrac{594}{s-8}$.

(2 marks)

(iii) $F(s)=\dfrac{4}{s^2+16}+\dfrac{20}{s^2-100}$.

(3 marks)

(iv) $F(s)=\dfrac{8}{9(s-10)}-\dfrac{2}{5(s+1)^3}$.

(4 marks)

(b) Given $Z(s)=\dfrac{123}{s^2+s-156}$.

(i) Factorize $s^2+s-156$.

(2 marks)

(ii) Find the partial fractions for $Z(s)$.

(4 marks)

(iii) Determine the inverse Laplace transform of $Z(s)$.

(4 marks)

Q2 Solve the differential equation below by using Laplace transform.

(a) $y''-3y'+2y=e^{-3t},\quad y(0)=1,\quad y'(0)=0$

(10 marks)

(b) $y''-4y=\sinh t,\quad y(0)=0,\quad y'(0)=0$

(10 marks)

SECTION B

Q3 (a) Use vertical line test to determine whether the graph shown in **Figure Q3(a)** is a function. Justify your answer.

(2 marks)

(b) Given $f(x)=\begin{cases} x+1, & x<2 \\ x^2, & x\geq 2 \end{cases}$.

(i) Calculate the value of $f(5)$ and $f(0)$.

(3 marks)

(c) Sketch the graph and determine the domain and range of the following:

(i) $f(x)=\dfrac{1}{x+2}-4.$

(4 marks)

(ii) $f(x)=-|x+3|+5.$

(4 marks)

(d) Given $f(x)=\dfrac{x}{2}+1$, $g(x)=x^3$ and $h(x)=-\dfrac{3}{x+1}$. Find

(i) $f^{-1}.$

(3 marks)

(ii) $h\circ f\circ g.$

(4 marks)

TERBUKA

Q4 (a) Based on **Figure Q4(a)**, find the limit of $h(x)$ if exist.

(i) $\lim\limits_{x \to -1^-} h(x)$.

(1 mark)

(ii) $\lim\limits_{x \to -1^+} h(x)$.

(1 mark)

(iii) $\lim\limits_{x \to 3^+} h(x)$.

(1 mark)

(b) Given $f(x) = \begin{cases} x^2 & 0 < x < 1 \\ 1 & 1 \le x < 2 \\ 2 & x = 2 \end{cases}$.

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

(2 marks)

(ii) State at which point $f(x)$ is continuous?

(1 mark)

(c) Calculate

(i) $\lim\limits_{x \to 9} \dfrac{3 - \sqrt{x}}{9 - x}$.

(3 marks)

(ii) $\lim\limits_{x \to 3} \dfrac{x^3 - 5x^2 + 6x}{x^2 - 3x}$.

(3 marks)

(iii) $\lim\limits_{x \to \infty} \dfrac{x^5 - 6x^2 - 2x}{2x^5 + 5x - 7}$.

(3 marks)

(d) Find the values of x which f is not continuous.

(i) $f(x) = \dfrac{x - 1}{x^2 + 4x - 5}$.

(3 marks)

(ii) $f(x) = \dfrac{3}{x - 1}$.

(2 marks)

Q5 (a) Given a function $f(x) = -3x^4 + x^3 + 8x^2 + 14$. Find all the derivatives $f''(x)$ and $f'''(x)$ of the function.

(2 marks)

(b) Differentiate function below.

(i) $y = 10x^4 - 3\sqrt{x}$.

(2 marks)

(ii) $y = e^{\cos(x) - 2x}$.

(3 marks)

(iii) $y = (\cos x + 5x)(4e^x + \tan x)$.

(4 marks)

(c) Let $y = \dfrac{7\ln x}{x^2 - 2}$, find $\dfrac{dy}{dx}$ at $x = 1$. TERBUKA

(4 marks)

(d) Given a function $2x^2 + 4y^3 + 12 = 6x + 5y$,

(i) Use implicit differentiation to find $\dfrac{dy}{dx}$.

(3 marks)

(ii) Find $\dfrac{dy}{dx}$ at $x = 2$ and $y = 1$.

(2 marks)

Q6 (a) A spherical balloon is to be deflated of a rate $x\ \text{cm}^3\text{s}^{-1}$. The radius of the balloon is decreasing at a rate of $0.6\ \text{cms}^{-1}$ when its volume is $288\pi\ \text{cm}^3$. Find the value of x.

(5 marks)

(b) Consider the function $f(x) = x^3 - 8x^2 + 16x$.

(i) Find the critical points.

(5 marks)

(ii) Find the interval(s) where the function is increasing or decreasing. Hence determine the extremum points.

(6 marks)

(c) Evaluate $\lim_{x \to 1} \frac{e^{x-1} - x}{x^2 - 2x + 1}$ by using L'Hopital's Rule.

(4 marks)

Q7 (a) Find the Laplace transforms for the functions below.

(i) $f(t) = \sin 5t - 2\cos t$.

(2 marks)

(ii) $f(t) = 3t - t^2 + 2e^{5t}$.

(2 marks)

(iii) $f(t) = \sinh 3t - \cosh 4t$

(2 marks)

(b) By using **First Shift Theorem** or **Multiply with t^n** method, find the Laplace transforms for the functions below.

(i) $f(t) = e^{-2t} \sin 5t$.

(3 marks)

(ii) $f(t) = 2t^2 \cosh t$.

(6 marks)

(c) Find the inverse Laplace transforms for function below.

$$F(s) = \frac{8s + 7}{8s^2 + 6s - 35}.$$

(5 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER/SESSION: SEM II/2016/2017 PROGRAMME : 1 DAE
COURSE NAME : ENGINEERING MATHEMATICS I COURSE CODE: DAS 10303

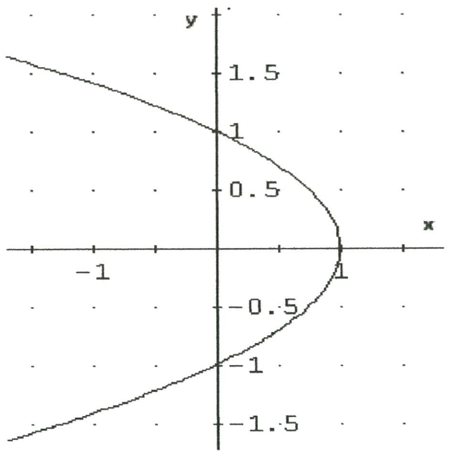

Figure Q3(a)

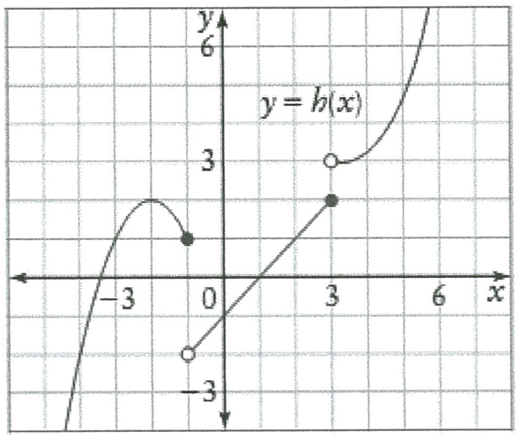

Figure Q4(a)

FINAL EXAMINATION

SEMESTER / SESSION: II/ 2016/2017 PROGRAMME : 1 DAE

COURSE : ENGINEERING MATHEMATICS I COURSE CODE : DAS 10303

Formulae

Differentiation

$$\frac{d}{dx}\left(ax^n\right)=nax^{n-1}$$

$$\frac{d}{ds}(\sin u)=\cos u.\frac{du}{dx}$$

$$\frac{d}{dx}\left(u^n\right)=nu^{n-1}.\frac{du}{dx}$$

$$\frac{d}{ds}(\cos u)=-\sin u.\frac{du}{dx}$$

$$\frac{d}{dx}\left(\frac{1}{\sqrt{u}}\right)=\frac{1}{2\sqrt{u}}.\frac{du}{dx}$$

$$\frac{d}{ds}(\tan u)=\sec^2 u.\frac{du}{dx}$$

$$\frac{d}{dx}\left(e^u\right)=e^u.\frac{du}{dx}$$

$$\frac{d}{ds}(\sec u)=\sec u.\tan u.\frac{du}{dx}$$

$$\frac{d}{dx}(\ln u)=\frac{1}{u}.\frac{du}{dx}$$

$$\frac{d}{ds}(\cot u)=-\csc^2 u.\frac{du}{dx}$$

$$\frac{d}{dx}(ku)=k.\frac{du}{dx}$$

$$\frac{d}{ds}(\csc u)=-\csc u.\cot u.\frac{du}{dx}$$

$$\frac{d}{dx}(uv)=uv'+vu'$$

$$\frac{d}{dx}\left(\frac{u}{v}\right)=\frac{vu'-uv'}{v^2}$$

TERBUKA

Parametric Differentiation

$$\frac{dy}{dx}=\frac{dy/dt}{dx/dt}=\frac{dy}{dt}\times\frac{dt}{dx}$$

FINAL EXAMINATION

SEMESTER / SESSION: II/ 2016/2017 PROGRAMME : 1 DAE

COURSE : ENGINEERING MATHEMATICS I COURSE CODE : DAS 10303

Laplace and Inverse Laplace Transforms

$$L\{f(t)\} = \int_0^\infty f(t)e^{-st}dt = F(s)$$

$f(t)$	$F(s)$
k	$\frac{k}{s}$
$t^n,\ n = 1, 2, ..$	$\frac{n!}{s^{n+1}}$
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	
$t^n f(t),\ n=1,2,..$	$(-1)^n \frac{d^n F(s)}{ds^n}$
The Unit Step Function	
$H(t-0)$	$\frac{1}{s}$
$H(t-a)$	$\frac{e^{-as}}{s}$

FINAL EXAMINATION

SEMESTER / SESSION: II/ 2016/2017 PROGRAMME : 1 DAE

COURSE : ENGINEERING MATHEMATICS I COURSE CODE : DAS 10303

The Second Shift Theorem	
$f(t-a)H(t-a)$	$e^{-as}F(s)$

Heaviside Function
$g(t)=g_1+[g_2-g_1]H(t-a)+[g_2-g_2]H(t-b)$

Initial Value Problem
$L\{y(t)\}=Y(s)$
$L\{y'(t)\}=sY(s)-y(0)$
$L\{y''(t)\}=s^2Y(s)-sy(0)-y'(0)$