# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER I
## SESSION 2016/2017



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|---|---|---|
| COURSE NAME | : | ENGINEERING MATHEMATICS I |
| COURSE CODE | : | DAS10303 |
| PROGRAMME | : | 3 DAE |
| EXAMINATION DATE | : | DECEMBER 2016 / JANUARY 2017 |
| DURATION | : | 3 HOURS |
| INSTRUCTIONS | : | SECTION A) ANSWER **ALL** QUESTIONS<br>SECTION B) ANSWER **THREE (3)** QUESTIONS ONLY |

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

## SECTION A

**Q1** (a) Find the inverse Laplace for these expressions

(i) $\frac{8}{s^3}+\frac{2}{s}$

(5 marks)

(ii) $\frac{2s+5}{(s+3)^2}$

(5 marks)

(b) Find $L^{-1}\left\{\frac{5s+1}{s^2-s-12}\right\}$

(10 marks)

**Q2** Solve the given initial and boundary value problem of differential equation using Laplace transform.

(a) $y''-6y'+8y=0$ ; Initial value problem : $y(0)=0,\quad y'(0)=-3$

(8 marks)

(b) $y''-7y'+12y=2$ ; Boundry value problem : $y=1,\ y'=5,$ when $t=0$.

(12 marks)

## SECTION B

**Q3** Sketch the graph and determine the domain and range.

(a) $y=x^2-5$

(5 marks)

(b) $y=\sqrt{x-4}$

(5 marks)

(c) $y=-\frac{1}{(x+4)^2}$

(5 marks)

(d) $y=\begin{cases}x^3+1 & , \quad x\geq 0\\ -x+2 & , \quad x<0\end{cases}$

(5 marks)

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

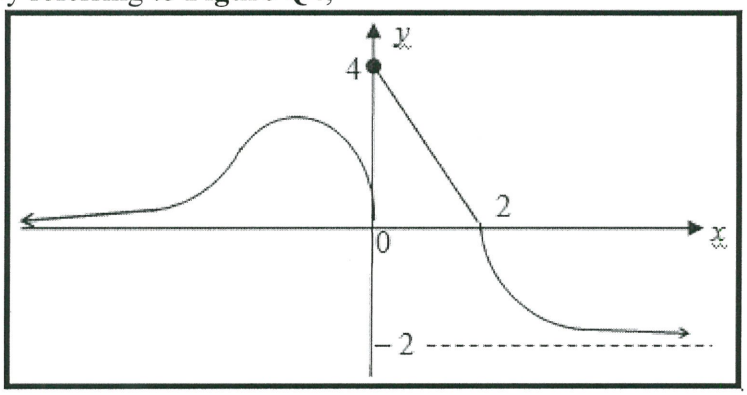


**Figure Q4**

(i) Find $\lim_{x\to 0^+} f(x)$, $\lim_{x\to 0^-} f(x)$ and $\lim_{x\to 0} f(x)$.

(3 marks)

(ii) Find $\lim_{x\to 2^+} f(x)$, $\lim_{x\to 2^-} f(x)$ and $\lim_{x\to 2} f(x)$. Verify whether $f(x)$ continuous at $x = 2$ or not.

(5 marks)

(iii) Find $\lim_{x\to +\infty} f(x)$ and $\lim_{x\to -\infty} f(x)$.

(2 marks)

(b) Evaluate the limits of the following expressions.

(i) $\lim_{x\to 1} \dfrac{x^3 - 5x^2 + 1}{x + 1}$

(2 marks)

(ii) $\lim_{x\to -1} \dfrac{x^2 - 2x - 3}{x + 1}$

(4 marks)

(iii) $\lim_{x\to 0} \dfrac{1 - \sqrt{1 + x}}{x}$

(4 marks)

**Q5** Differentiate the following functions:

(a) $y = -2x^4 + 3x - 7 - \frac{1}{x} + 4\sqrt{x}$

(3 marks)

(b) $y = \sin(e^{3x^2})$

(3 marks)

(c) $3x^2 + y^3 = 4$ by using implicit differentiation.

(4 marks)

(d) $y = (x^4 + x^2 + 6x - \frac{1}{x^2})(x^3 - 3x + 4)$ by using product rule.

(5 marks)

(e) $y = \frac{\ln x + \cos x}{x^2 - 4x}$ by using quotient rule.

(5 marks)

**Q6** (a) By using L'Hospital's Rule, find

(i) $\lim_{x \to 0} \frac{2x^2 - x}{2x^3}$

(2 marks)

(ii) $\lim_{x \to \infty} \frac{\ln(x-1)}{x}$

(3 marks)

(iii) $\lim_{x \to \infty} \frac{3e^x}{x^2}$

(3 marks)

(b) Given a curve $f(x) = \frac{1}{3}x^3 + 2x^2 - 5x + 1$

(i) Find the critical points and inflection point.

(4 marks)

(ii) Fill up the **Table Q6**.

(5 marks)

**Table Q6**

| **Value Type** | Test Value | Critical Value | Test Value | Inflection point | Test value | Critical Value | Test Value |
|---|---|---|---|---|---|---|---|
| $x$ | $x=$ | $x=$ | $x=$ | $x=$ | $x=$ | $x=$ | $x=$ |
| $f(x)$ | | | | | | | |
| $f'(x)$ | | | | | | | |
| $f''(x)$ | | | | | | | |
| **Graph Characteristics** | | | | | | | |

(iii) State the minimum or maximum point and inflection points if exist.

(3 marks)

**Q7** Find the Laplace trasform

(a) $\frac{1}{6}e^{-3t} + t^5$

(2 marks)

(b) $12t^5 + \cosh 3t$

(3 marks)

(c) $e^{-3t} - 5\cos 4t + 5$

(5 marks)

(d) $6e^{-3t} - 5t^4 + 7$

(5 marks)

(e) $5e^{-t} - \sinh 3t + 2t^7 + 6$

(5 marks)

**– END OF QUESTION –**

**FINAL EXAMINATION**

SEMESTER / SESSION : SEM I 2016/2017 PROGRAMME : 3 DAE
COURSE : ENGINEERING MATHEMATICS I COURSE CODE : DAS 10303

**Table 1 : Laplace transform.**

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

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

**Table 2 : Initial and Boundary Value Problem**

If $L\{y(t)\}= Y(s)$ then

$L\{y'(t)\}= sY(s)-y(0)$

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

**Table 3 : Indefinite differentiation**

| |
|---|
| $\frac{d}{dx}\left[x^n\right]=nx^{n-1}$ |
| $\frac{d}{dx}\left[e^x\right]=e^x$ |
| $\frac{d}{dx}\left[\ln\lvert x\rvert\right]=\frac{1}{x}$ |
| $\frac{d}{dx}\left[\sin x\right]=\cos x$ |
| $\frac{d}{dx}\left[\cos x\right]=-\sin x$ |
| $\frac{d}{dx}\left[\tan x\right]=\sec^2 x$ |
| $\frac{d}{dx}\left[\cot x\right]=-\csc^2 x$ |
| $\frac{d}{dx}\left[\sec x\right]=\sec x\tan x$ |
| $\frac{d}{dx}\left[\csc x\right]=-\csc x\cot x$ |

**Table 4 : Differentiation**

**Differentiation - Product Rule :**

$$\frac{d}{dx}[u.v]=u\,v'+v\,u'$$

**Differentiation – Quotient Rule :**

$$\frac{d}{dx}\left[\frac{u}{v}\right]=\frac{v\,u'-u\,v'}{v^2}$$

**Differentiation – Chain Rule**

$$(f\cdot g)'(x)=f'((g(x))g'(x)$$