

9

SULIT



BAHAGIAN PEPERIKSAAN DAN PENILAIAN  
JABATAN PENDIDIKAN POLITEKNIK  
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN MATEMATIK, SAINS & KOMPUTER

PEPERIKSAAN AKHIR  
SESI DISEMBER 2015

BA601: ENGINEERING MATHEMATICS 5

TARIKH : 06 APRIL 2016  
MASA : 8.30 AM - 10.30AM (2 JAM)

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Kertas ini mengandungi **LIMA BELAS (15)** halaman bercetak.

Bahagian A: Struktur (2 soalan)

Bahagian B: Struktur (2 soalan)

Bahagian C: Struktur (2 soalan)

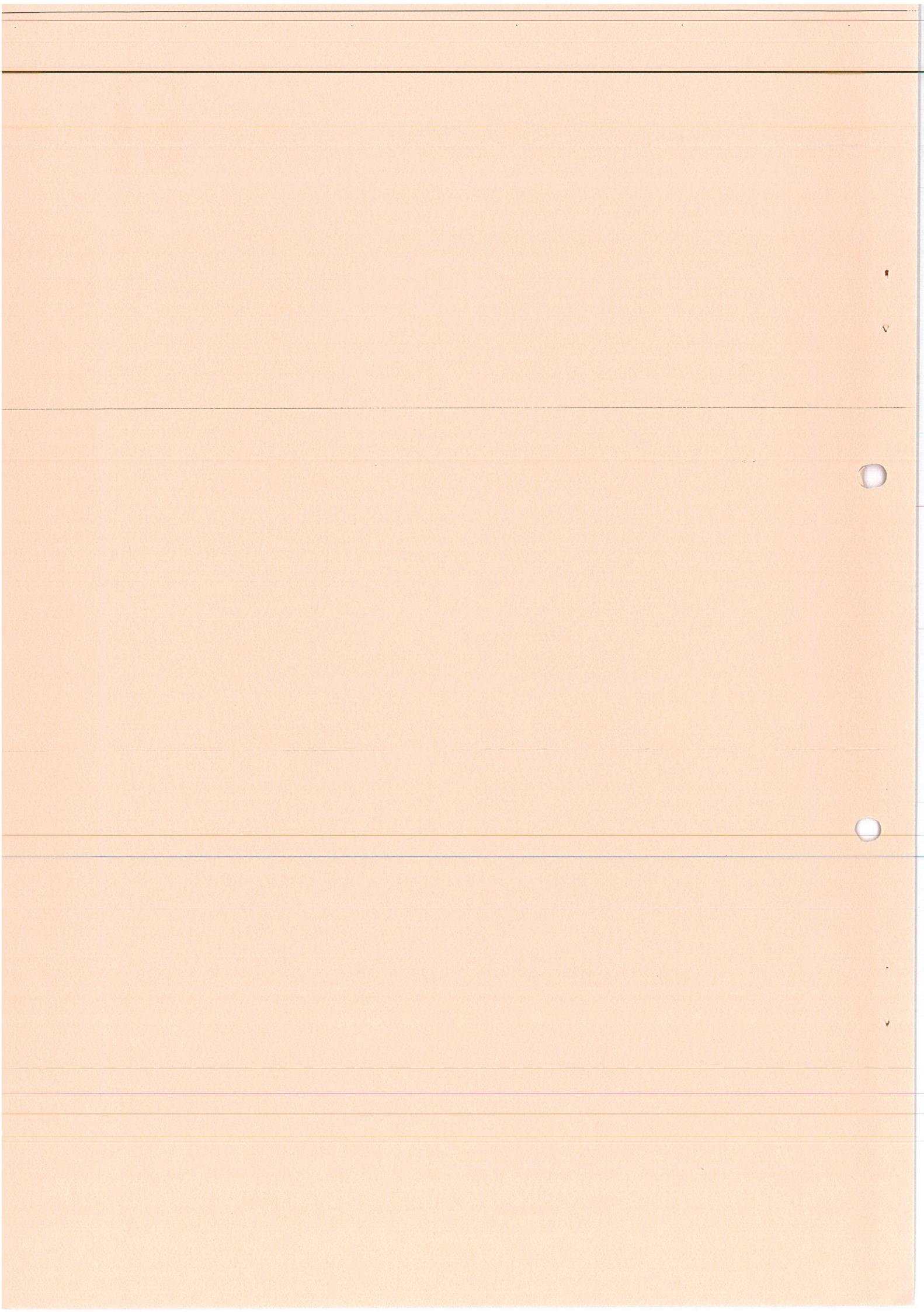
Dokumen sokongan yang disertakan : Formula

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JANGAN BUKA KERTAS SOALANINI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT



**SECTION A : 50 MARKS****BAHAGIAN A : 50 MARKAH****INSTRUCTION:**

This section consists of TWO (2) questions with 25 marks each. Answer ONE (1) question from each part, and ONE (1) question from either part A/B/C.

**ARAHAH:**

Bahagian ini mengandungi DUA (2) soalan dengan jumlah 25 markah setiap satu.  
Jawab SATU (1) soalan dari setiap bahagian, dan SATU (1) soalan selebihnya dari  
mana-mana bahagian samaada A/B/C.

**QUESTION 1****SOALAN 1**CLO1  
C1

- (a) Find the value of the following functions :

*Dapatkan nilai bagi fungsi-fungsi yang berikut :*

i.  $\sinh 3$  [2 marks]  
[2 markah]

ii.  $\operatorname{sech}(-5)$  [2 marks]  
[2 markah]

iii.  $\coth 1.5$  [2 marks]  
[2 markah]

CLO 1  
C3

- (b) Show that
- $\coth^{-1} t = \frac{1}{2} \ln \frac{t+1}{t-1}$
- .

*Buktikan bahawa*  $\coth^{-1} t = \frac{1}{2} \ln \frac{t+1}{t-1}$ .

[7 marks]

[7 markah]

CLO 1  
C2

- (c) Solve the equation
- $\sec^{-1} 3y = \frac{\pi}{3}$
- .

*Selesaikan persamaan*  $\sec^{-1} 3y = \frac{\pi}{3}$ .

[3 marks]

[3 markah]

**SECTION B : 50 MARKS****BAHAGIAN B : 50 MARKAH****INSTRUCTION:**

This section consists of TWO (2) questions with 25 marks each. Answer ONE (1) question from each part, and ONE (1) question from either part A/B/C.

**ARAHAN:**

Bahagian ini mengandungi DUA (2) soalan dengan jumlah 25 markah setiap satu.

Jawab SATU (1) soalan dari setiap bahagian, dan SATU (1) soalan selebihnya dari mana-mana bahagian samaada A/B/C.

**QUESTION 3****SOALAN 3**CLO2  
C3

- (a) Differentiate each of the following equations with respect to  $x$ :

Bezakan setiap persamaan berikut terhadap  $x$ :

i.  $y = \cosh(2 - 3x^2)$  [3 marks]

[3 markah]

ii.  $y = x^2 \sec^{-1}(2x)$  [4 marks]

[4 markah]

iii.  $y = e^{4x} \tanh^{-1}(x)$  [4 marks]

[4 markah]

CLO2  
C3

- (b) Given
- $z = \sqrt{y} - \sin(xy) + 5x^2$
- . Calculate:

*Diberi  $z = \sqrt{y} - \sin(xy) + 5x^2$ . Kirakan:*

i.  $\frac{\partial z}{\partial x}$  [3 marks]  
 [3 markah]

ii.  $\frac{\partial z}{\partial y}$  [3 marks]  
 [3 markah]

iii.  $\frac{\partial^2 z}{\partial x^2}$  [3 marks]  
 [3 markah]

CLO2  
C3

- (c) Use implicit differentiation method to determine the derivative for the following functions.

*Gunakan kaedah pembezaan tersirat untuk menentukan pembezaan bagi fungsi yang berikut.*

$$y + xy = y^2 + 8x - 5$$

[5 marks]  
 [5 markah]

## QUESTION 4

## SOALAN 4

CLO2  
C3

- (a) Determine the following integrals:

*Tentukan setiap kamiran berikut:*

i.  $\int -6 \operatorname{sech}(3x) \tanh(3x) dx$  [3 marks]

[3 markah]

ii.  $\int 4x^3 \sinh 5x^4 dx$  [5 marks]

[5 markah]

iii.  $\int \frac{3}{x\sqrt{25x^2 - 4}} dx$  [5 marks]

[5 markah]

CLO2  
C3

- (b) Solve the following integral:

*Selesaikan kamiran yang berikut:*

i.  $\int \frac{1}{\sqrt{4x^2 + 16x - 65}} dx$  [6 marks]

[6 markah]

ii.  $\int xe^{\frac{x}{2}} dx$  [6 marks]

[6 markah]

## QUESTION 6

## SOALAN 6

CLO3  
C3

- (a) Solve the following differential equation;

*Selesaikan persamaan pembezaan berikut:*

i.  $\frac{dy}{dx} + 2y = e^{2x}$  [4 marks]

*[4 markah]*

ii.  $\frac{dy}{dx} = \frac{x+y}{2x}$  [7 marks]

*[7 markah]*CLO3  
C3

- (b) Solve the following second order differential equation;

*Selesaikan persamaan pembezaan peringkat kedua berikut:*

i.  $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 3y = 0$  [4 marks]

*[4 markah]*

ii.  $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 4y = 0$  [4 marks]

*[4 markah]*

iii.  $2\frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$  [6 marks]

*[6 markah]*

SOALAN TAMAT

# FORMULA ENGINEERING MATHEMATICS 5

| HYPERBOLIC FUNCTIONS  | INVERSE HYPERBOLIC FUNCTIONS   |
|---|--|
| $\sinh x = \frac{e^x - e^{-x}}{2}$<br>$\cosh x = \frac{e^x + e^{-x}}{2}$<br>$\tanh x = \frac{e^x - e^{-x}}{e^x + e^{-x}}$<br>$\coth x = \frac{e^x + e^{-x}}{e^x - e^{-x}}; x \neq 0$<br>$\sec h x = \frac{2}{e^x + e^{-x}}$<br>$\operatorname{cosech} x = \frac{2}{e^x - e^{-x}}; x \neq 0$   | $\sinh^{-1} x = \ln \left( x + \sqrt{x^2 + 1} \right); -\infty < x < \infty$<br>$\cosh^{-1} x = \ln \left( x + \sqrt{x^2 - 1} \right); x \geq 1$<br>$\tanh^{-1} x = \frac{1}{2} \ln \left( \frac{1+x}{1-x} \right);  x  < 1$<br>$\coth^{-1} x = \frac{1}{2} \ln \left( \frac{x+1}{x-1} \right);  x  > 1$<br>$\operatorname{sech}^{-1} x = \ln \left( \frac{1 + \sqrt{1-x^2}}{x} \right); 0 < x \leq 1$<br>$\operatorname{cosech}^{-1} x = \ln \left( \frac{1}{x} + \frac{\sqrt{1+x^2}}{ x } \right); x \neq 0$ |
| RECIPROCAL TRIGONOMETRIC IDENTITIES   | RECIPROCAL HYPERBOLIC IDENTITIES   |
| $\operatorname{cosec} x = \frac{1}{\sin x}$<br>$\sec x = \frac{1}{\cos x}$<br>$\cot x = \frac{1}{\tan x}$   | $\operatorname{cosech} x = \frac{1}{\sinh x}$<br>$\operatorname{sech} x = \frac{1}{\cosh x}$<br>$\coth x = \frac{1}{\tanh x}$  |
| TRIGONOMETRIC IDENTITIES  | HYPERBOLIC IDENTITIES  |
| $\cos^2 x + \sin^2 x = 1$<br>$1 + \tan^2 x = \sec^2 x$<br>$\cot^2 x + 1 = \operatorname{cosec}^2 x$<br>$\sin 2x = 2 \sin x \cos x$<br>$\cos 2x = \cos^2 x - \sin^2 x = 2 \cos^2 x - 1 = 1 - 2 \sin^2 x$<br>$\tan 2x = \frac{2 \tan x}{1 - \tan^2 x}$<br>$\sin(x \pm y) = \sin x \cos y \pm \cos x \sin y$<br>$\cos(x \pm y) = \cos x \cos y \mp \sin x \sin y$<br>$\tan(x \pm y) = \frac{\tan x \pm \tan y}{1 \mp \tan x \tan y}$ | $\cosh^2 x - \sinh^2 x = 1$<br>$1 - \tanh^2 x = \operatorname{sech}^2 x$<br>$\coth^2 x - 1 = \operatorname{cosech}^2 x$<br>$\sinh 2x = 2 \sinh x \cosh x$<br>$\cosh 2x = \cosh^2 x + \sinh^2 x = 2 \cosh^2 x - 1 = 1 + 2 \sinh^2 x$<br>$\tanh 2x = \frac{2 \tanh x}{1 + \tanh^2 x}$<br>$\sinh(x \pm y) = \sinh x \cosh y \pm \cosh x \sinh y$<br>$\cosh(x \pm y) = \cosh x \cosh y \pm \sinh x \sinh y$<br>$\tanh(x \pm y) = \frac{\tanh x \pm \tanh y}{1 \pm \tanh x \tanh y}$                                |

# FORMULA ENGINEERING MATHEMATICS 5

| <b>BASIC OF DIFFERENTIATION</b>  | <b>BASIC OF INTEGRATION</b>  |
|--|--|
| $\frac{d}{dx}(k) = 0; k = \text{constant}$ $\frac{d}{dx}(u^n) = nu^{n-1}$ $\frac{d}{dx}(\ln u ) = \frac{1}{u} \cdot \frac{du}{dx}$ $\frac{d}{dx}(e^u) = e^u \cdot \frac{du}{dx}$   | $\int k du = ku + C; k = \text{constant}$ $\int u^n du = \frac{u^{n+1}}{n+1} + C; n \neq -1$ $\int \frac{1}{u} du = \frac{\ln u }{\left(\frac{du}{dx}\right)} + C$ $\int e^u du = \frac{e^u}{\left(\frac{du}{dx}\right)} + C$  |
| <b>DIFFERENTIATION OF TRIGONOMETRIC FUNCTIONS</b>  | <b>INTEGRATION OF TRIGONOMETRIC FUNCTIONS</b>  |
| $\frac{d}{dx}(\cos u) = -\sin u \cdot \frac{du}{dx}$ $\frac{d}{dx}(\sin u) = \cos u \cdot \frac{du}{dx}$ $\frac{d}{dx}(\tan u) = \sec^2 u \cdot \frac{du}{dx}$ $\frac{d}{dx}(\cot u) = -\operatorname{cosec}^2 u \cdot \frac{du}{dx}$ $\frac{d}{dx}(\sec u) = \sec u \cdot \tan u \cdot \frac{du}{dx}$ $\frac{d}{dx}(\operatorname{cosec} u) = -\operatorname{cosec} u \cdot \cot u \cdot \frac{du}{dx}$   | $\int \sin u du = \frac{-\cos u}{\left(\frac{du}{dx}\right)} + C$ $\int \cos u du = \frac{\sin u}{\left(\frac{du}{dx}\right)} + C$ $\int \sec^2 u du = \frac{\tan u}{\left(\frac{du}{dx}\right)} + C$ $\int \operatorname{cosec}^2 u du = \frac{-\cot u}{\left(\frac{du}{dx}\right)} + C$ $\int \sec u \tan u du = \frac{\sec u}{\left(\frac{du}{dx}\right)} + C$ $\int \operatorname{cosec} u \cot u du = \frac{-\operatorname{cosec} u}{\left(\frac{du}{dx}\right)} + C$   |
| <b>DIFFERENTIATION OF HYPERBOLIC FUNCTIONS</b>   | <b>INTEGRATION OF HYPERBOLIC FUNCTIONS</b>   |
| $\frac{d}{dx}(\cosh u) = \sinh u \cdot \frac{du}{dx}$ $\frac{d}{dx}(\sinh u) = \cosh u \cdot \frac{du}{dx}$ $\frac{d}{dx}(\tanh u) = \operatorname{sech}^2 u \cdot \frac{du}{dx}$ $\frac{d}{dx}(\coth u) = -\operatorname{cosech}^2 u \cdot \frac{du}{dx}$ $\frac{d}{dx}(\operatorname{sech} u) = -\operatorname{sech} u \cdot \tanh u \cdot \frac{du}{dx}$ $\frac{d}{dx}(\operatorname{cosech} u) = -\operatorname{cosech} u \cdot \coth u \cdot \frac{du}{dx}$ | $\int \sinh u du = \frac{\cosh u}{\left(\frac{du}{dx}\right)} + C$ $\int \cosh u du = \frac{\sinh u}{\left(\frac{du}{dx}\right)} + C$ $\int \operatorname{sech}^2 u du = \frac{\tanh u}{\left(\frac{du}{dx}\right)} + C$ $\int \operatorname{cosech}^2 u du = \frac{-\coth u}{\left(\frac{du}{dx}\right)} + C$ $\int \operatorname{sech} u \tanh u du = \frac{-\operatorname{sech} u}{\left(\frac{du}{dx}\right)} + C$ $\int \operatorname{cosech} u \coth u du = \frac{-\operatorname{cosech} u}{\left(\frac{du}{dx}\right)} + C$ |

# FORMULA ENGINEERING MATHEMATICS 5

| DIFFERENTIATION OF INVERSE TRYGONOMETRIC FUNCTIONS                                  | INTEGRATION OF INVERSE TRYGONOMETRIC FUNCTION   |
|---|---|
| $\frac{d}{dx}(\sin^{-1} u) = \frac{1}{\sqrt{1-u^2}} \frac{du}{dx},  u  < 1$         | $\int \frac{1}{\sqrt{a^2-u^2}} du = \sin^{-1} \frac{u}{a} + C,  u  < a$                   |
| $\frac{d}{dx}(\cos^{-1} u) = -\frac{1}{\sqrt{1-u^2}} \frac{du}{dx},  u  < 1$        | $\int -\frac{1}{\sqrt{a^2-u^2}} du = \cos^{-1} \frac{u}{a} + C,  u  < a$                  |
| $\frac{d}{dx}(\tan^{-1} u) = \frac{1}{1+u^2} \frac{du}{dx}$                         | $\int \frac{1}{a^2+u^2} du = \frac{1}{a} \tan^{-1} \frac{u}{a} + C$                       |
| $\frac{d}{dx}(\cot^{-1} u) = -\frac{1}{1+u^2} \frac{du}{dx}$                        | $\int -\frac{1}{a^2+u^2} du = \frac{1}{a} \cot^{-1} \frac{u}{a} + C$                      |
| $\frac{d}{dx}(\sec^{-1} u) = \frac{1}{ u \sqrt{u^2-1}} \frac{du}{dx},  u  > 1$      | $\int \frac{1}{ u \sqrt{u^2-a^2}} du = \frac{1}{a} \sec^{-1} \frac{u}{a} + C,  u  > a$    |
| $\frac{d}{dx}(\cosec^{-1} u) = -\frac{1}{ u \sqrt{u^2-1}} \frac{du}{dx},  u  > 1$   | $\int -\frac{1}{ u \sqrt{u^2-a^2}} du = \frac{1}{a} \cosec^{-1} \frac{u}{a} + C,  u  > a$ |
| DIFFERENTIATION OF INVERSE HYPERBOLIC FUNCTIONS                                     | INTEGRATION OF INVERSE HYPERBOLIC FUNCTIONS   |
| $\frac{d}{dx}(\sinh^{-1} u) = \frac{1}{\sqrt{u^2+1}} \frac{du}{dx}$                 | $\int \frac{1}{\sqrt{a^2+u^2}} du = \sinh^{-1} \frac{u}{a} + C, a > 0$                    |
| $\frac{d}{dx}(\cosh^{-1} u) = \frac{1}{\sqrt{u^2-1}} \frac{du}{dx},  u  > 1$        | $\int \frac{1}{\sqrt{u^2-a^2}} du = \cosh^{-1} \frac{u}{a} + C, u > a$                    |
| $\frac{d}{dx}(\tanh^{-1} u) = \frac{1}{1-u^2} \frac{du}{dx},  u  < 1$               | $\int \frac{1}{a^2-u^2} du = \frac{1}{a} \tanh^{-1} \frac{u}{a} + C;  u  < a$             |
| $\frac{d}{dx}(\coth^{-1} u) = \frac{1}{1-u^2} \frac{du}{dx},  u  > 1$               | $\int \frac{1}{u^2-a^2} du = \frac{1}{a} \coth^{-1} \frac{u}{a} + C;  u  > a$             |
| $\frac{d}{dx}(\sech^{-1} u) = -\frac{1}{u\sqrt{1-u^2}} \frac{du}{dx}, 0 < u < 1$    | $\int \frac{1}{u\sqrt{a^2-u^2}} du = -\frac{1}{a} \sech^{-1} \frac{u}{a} + C$             |
| $\frac{d}{dx}(\cosech^{-1} u) = -\frac{1}{ u \sqrt{1+u^2}} \frac{du}{dx}, u \neq 0$ | $\int \frac{1}{u\sqrt{a^2+u^2}} du = -\frac{1}{a} \cosech^{-1} \frac{u}{a} + C$           |

## INTERGRALS INVOLVING QUADRATIC EXPRESSION

Completing the square

$$ax^2 + bx + c = a \left( x + \frac{b}{2a} \right)^2 + c - \frac{b^2}{4a}$$

# FORMULA ENGINEERING MATHEMATICS 5

## SOLUTION FOR 1<sup>st</sup> ORDER DIFFERENTIAL EQUATION

Homogeneous Equations

- Substitution

$$y = vx \quad \text{and} \quad \frac{dy}{dx} = v + x \frac{dy}{dx}$$

Linear Factors (Integrating Factors)

$$y \bullet IF = \int Q \bullet IF dx$$

$$\text{Where } IF = e^{\int P dx}$$

**Logarithmic**

$$a = e^{\ln a}$$

$$a^x = e^{x \ln a}$$

$$\int a^x dx = \frac{a^x}{\ln a} + c$$

## GENERAL SOLUTION FOR 2<sup>nd</sup> ORDER DIFFERENTIAL EQUATION

Equation of the form  $a \frac{d^2 y}{dx^2} + b \frac{dy}{dx} + cy = 0$

1. Real & different roots:

$$y = Ae^{m_1 x} + Be^{m_2 x}$$

2. Real & equal roots:

$$y = e^{mx}(A + Bx)$$

3. Complex roots:

$$y = e^{\alpha x}(A \cos \beta x + B \sin \beta x)$$