

SULIT



BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK
KEMENTERIAN PENDIDIKAN MALAYSIA

JABATAN MATEMATIK, SAINS DAN KOMPUTER

PEPERIKSAAN AKHIR
SESI DISEMBER 2014

BA601: ENGINEERING MATHEMATICS 5

TARIKH : 06 APRIL 2015
MASA : 2.30 PM - 4.30 PM (2 JAM)

Kertas ini mengandungi **EMPAT BELAS (14)** halaman bercetak.

Bahagian A: Struktur (2 soalan)

Bahagian B: Struktur (2 soalan)

Bahagian C: Struktur (2 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALANINI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

SULIT

SECTION A

BAHAGIAN A

INSTRUCTION:

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

ARAHAN :

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

QUESTION 1**SOALAN 1**CLO1
C2

- (a) Find the value for each of the following by using the definition/formula of hyperbolic functions:

Cari nilai bagi setiap yang berikut dengan menggunakan definisi/formula fungsi hiperbolik.

i. $\cosh \sqrt{8}$

[2 marks]
[2 markah]

ii. $\tanh(-2.5)$

[2 marks]
[2 markah]

iii. $\sinh^{-1}(\ln 2)$

[2 marks]
[2 markah]

iv. $\operatorname{cosech}^{-1}(-3)$

[2 marks]
[2 markah]

CLO1
C3

(b) Prove that

Buktikan bahawa

i. $\cosh x - \sinh x = e^{-x}$

[3 marks]

ii. $\cosh(A+B) = \cosh A \cosh B + \sinh A \sinh B$

[6 marks]
[6 markah]CLO1
C2

(c) Sketch a quadrant graph and find the principal value for the following functions:

Lakarkan graf sukuhan dan dapatkan nilai utama bagi fungsi-fungsi berikut:

i. $\cos^{-1}(-0.35)$

[4 marks]
[4 markah]

ii. $\tan^{-1}(1.192)$

[4 marks]
[4 markah]

QUESTION 2**SOALAN 2**CLO1
C3

- (a) Find the value for each of the following by using the definition/formula of hyperbolic functions:

Cari nilai bagi setiap fungsi yang berikut dengan menggunakan definisi/formula fungsi hiperbolik:

v. $\sinh(\ln 5)$

[2 marks]
[2 markah]

vi. $\operatorname{sech}^{-1}(0.72)$

[2 marks]
[2 markah]

vii. $\cosh^{-1}\left(\frac{3}{2}\right) + \coth\left(\frac{5}{4}\right)$

[4 marks]
[4 markah]

CLO1
C2

- (b) Complete the table below for equation $y = 2 \sinh \frac{2x}{3}$. Then sketch the graph in the range of $-4 \leq x \leq 4$.

Lengkapkan jadual di bawah bagi persamaan $y = 2 \sinh \frac{2x}{3}$. Seterusnya lakarkan graf pada julat $-4 \leq x \leq 4$.

x	-4	-2	0	2	4
y					

[5 marks]
[5 markah]

CLO1
C3(c) Given that $\cosh x - \sinh x = me^{-x}$, find the value of m .*Diberi $\cosh x - \sinh x = me^{-x}$, cari nilai bagi m .*[4 marks]
[4 markah]CLO1
C3(d) Prove that $\tanh^{-1} x = \frac{1}{2} \ln\left(\frac{1+x}{1-x}\right)$ *Buktikan $\tanh^{-1} x = \frac{1}{2} \ln\left(\frac{1+x}{1-x}\right)$* [8 marks]
[8 markah]

SECTION B
BAHAGIAN B
INSTRUCTION:

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

ARAHAN :

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

QUESTION 3
SOALAN 3

 CLO2
 C3

- (a) Differentiate the following functions with respect to x .

Bezakan setiap fungsi yang berikut terhadap x .

i. $y = \tanh^{-1}\left(\frac{x}{4}\right)$

[3 marks]
 [3 markah]

ii. $y = e^{\ln(\cosh x)}$

[4 marks]
 [4 markah]

iii. $y = \frac{\cos^{-1}(3x)}{2x}$

[5 marks]
 [5 markah]

 CLO2
 C3

- (b) Determine $\frac{dy}{dx}$ for the implicit function $\cosh x^2 + \ln y = x^2 y^3 + 5$.

Tentukan $\frac{dy}{dx}$ untuk fungsi tersirat $\cosh x^2 + \ln y = x^2 y^3 + 5$

[7 marks]
[7 markah]

CLO2
C3

(c) Given $z = 4y \cosh(3x) + 3x \sinh(2y)$, find $\frac{\partial z}{\partial x}, \frac{\partial z}{\partial y}, \frac{\partial^2 z}{\partial x^2}, \frac{\partial^2 z}{\partial y^2}, \frac{\partial^2 z}{\partial x \partial y}$ and $\frac{\partial^2 z}{\partial y \partial x}$.

Diberi $z = 4y \cosh(3x) + 3x \sinh(2y)$, cari $\frac{\partial z}{\partial x}, \frac{\partial z}{\partial y}, \frac{\partial^2 z}{\partial x^2}, \frac{\partial^2 z}{\partial y^2}, \frac{\partial^2 z}{\partial x \partial y}$ and $\frac{\partial^2 z}{\partial y \partial x}$.

[6 marks]
[6 markah]

SULIT**QUESTION 4****SOALAN 4**CLO2
C3(a) Integrate the following functions with respect to x .*Kamirkan fungsi-fungsi berikut terhadap x .*

i. $\int \sinh(9 - 7x)dx$

[3 marks]

[3 markah]

ii. $\int 5\cosh^3 x \sinh x dx$

[5 marks]

[5 markah]

iii. $\int \frac{3}{7 - (x + 2)^2} dx$

[5 marks]

[5 markah]

CLO2
C3

(b) Solve the following integrals:

Selesaikan kamiran yang berikut:

i. $\int \frac{3x}{(x+3)(x+2)} dx$

[6 marks]

[6 markah]

ii. $\int_0^1 \frac{1}{1 + 9x^2} dx$

[6 marks]

[6 markah]

SECTION C
BAHAGIAN C

INSTRUCTION:

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

ARAHAN :

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

QUESTION 5
SOALAN 5

CLO3
C3

- (a) Form a differential equation for each of the following functions:

Bentukkan persamaan pembezaan bagi setiap fungsi yang berikut:

i. $y = Ax^3 - 6Bx$ [6 marks]
[6 markah]

ii. $y = 4A \cosh 2x - 4B \sinh 2x$ [4 marks]
[4 markah]

CLO3
C4

- (b) Solve the following differential equations:

Selesaikan persamaan pembezaan berikut:

i. $e^{y-x} \frac{dy}{dx} = e^x$ [3 marks]
[3 markah]

ii. $\frac{dy}{dx} = \frac{xy}{x^2-y^2}$ [5 marks]
[5 markah]

iii. $x^2 \frac{dy}{dx} + xy = 3x^3$ [7 marks]
[7 markah]

QUESTION 6
SOALAN 6

CLO3
C3

(a) Solve the following differential equations:

Selesaikan persamaan pembezaan berikut:

i. $\frac{dy}{dx} = \frac{5x^2}{3y^2 + 7}$

[6 marks]
[6 markah]

ii. $\frac{dy}{dx} + 5y = e^{5x}$

[5 marks]
[5 markah]

CLO3
C3

(b) Solve the following second order of differential equations:

Selesaikan persamaan pembezaan peringkat kedua berikut:

i. $\frac{d^2y}{dx^2} + 9\frac{dy}{dx} + 20y = 0$

[4 marks]
[4 markah]

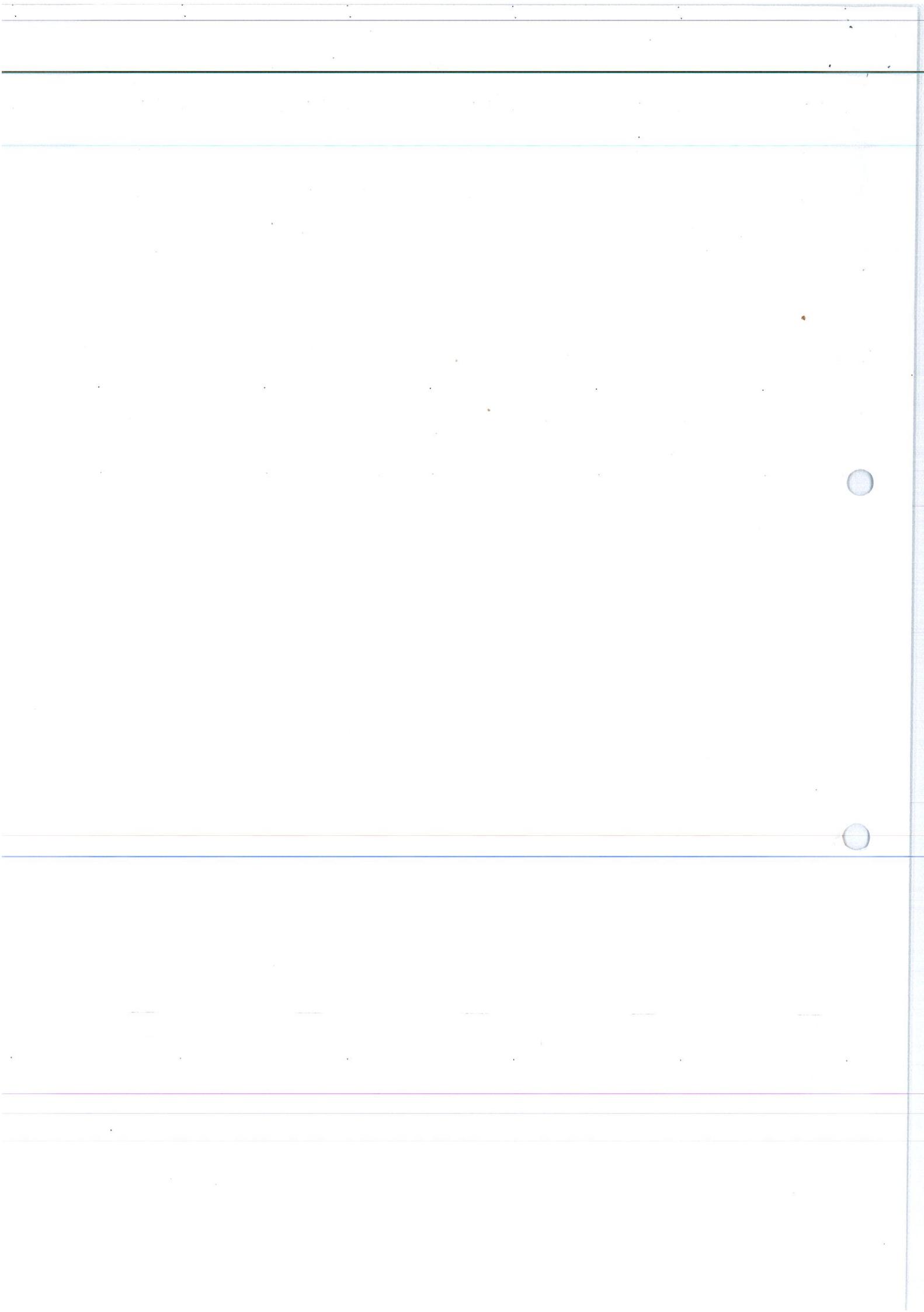
ii. $\frac{d^2y}{dx^2} + 14\frac{dy}{dx} + 49y = 0$

[4 marks]
[4 markah]

iii. $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + 7y = 0$

[6 marks]
[6 markah]

SOALAN TAMAT



FORMULA ENGINEERING MATHEMATICS 5

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

FORMULA ENGINEERING MATHEMATICS 5

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

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
$\frac{d}{dx}(\sinh^{-1} u) = \frac{1}{\sqrt{u^2+1}} \frac{du}{dx}$	$\int \frac{1}{\sqrt{a^2+u^2}} du = \sinh^{-1} \frac{u}{a} + C, a > 0$
$\frac{d}{dx}(\cosh^{-1} u) = \frac{1}{\sqrt{u^2-1}} \frac{du}{dx}, u > 1$	$\int \frac{1}{\sqrt{u^2-a^2}} du = \cosh^{-1} \frac{u}{a} + C, u > a$
$\frac{d}{dx}(\tanh^{-1} u) = \frac{1}{1-u^2} \frac{du}{dx}, u < 1$	$\int \frac{1}{a^2-u^2} du = \frac{1}{a} \tanh^{-1} \frac{u}{a} + C; u < a$
$\frac{d}{dx}(\coth^{-1} u) = \frac{1}{1-u^2} \frac{du}{dx}, u > 1$	$\int \frac{1}{u^2-a^2} du = \frac{1}{a} \coth^{-1} \frac{u}{a} + C; u > a$
$\frac{d}{dx}(\sec h^{-1} u) = -\frac{1}{u\sqrt{1-u^2}} \frac{du}{dx}, 0 < u < 1$	$\int \frac{1}{u\sqrt{a^2-u^2}} du = -\frac{1}{a} \operatorname{sech}^{-1} \frac{u}{a} + C$
$\frac{d}{dx}(\cosech^{-1} u) = -\frac{1}{ u \sqrt{1+u^2}} \frac{du}{dx}, u \neq 0$	$\int \frac{1}{u\sqrt{a^2+u^2}} du = -\frac{1}{a} \operatorname{cosech}^{-1} \frac{u}{a} + C$

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 1st ORDER DIFFERENTIAL EQUATION

Homogeneous Equations

- Substitution

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

Linear Factors (Integrating Factors)

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

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

Logarithmic

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

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

GENERAL SOLUTION FOR 2nd ORDER DIFFERENTIAL EQUATION

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

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:

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

ROOTS OF QUADRATIC EQUATIONS

$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$